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PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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THE AMERICAN
INSTITUTE OF ELECTRICAL ENGINEERS

ABSTRACTS 2844–3681

OLUME 53 **MAY 1950** NUMBER 629

The FINCH

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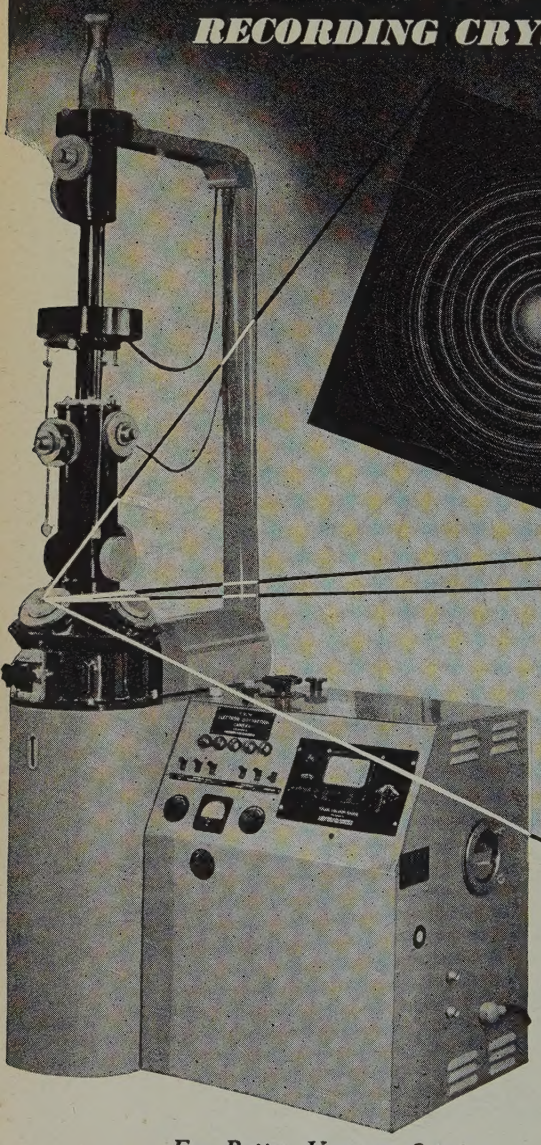

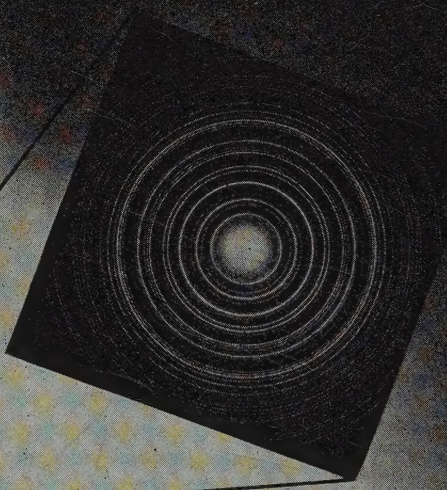

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  METALS
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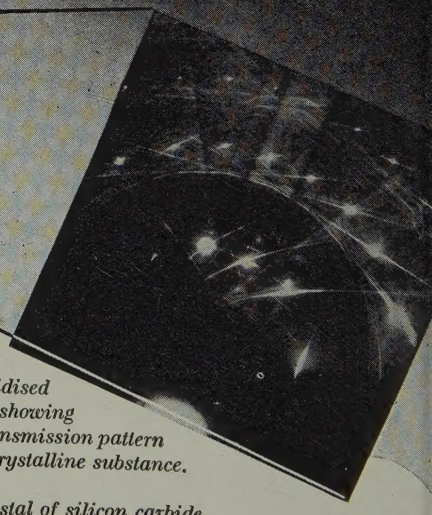

(top)
Partly oxidised tin foil, showing typical transmission pattern of a polycrystalline substance.
(right)
Single crystal of silicon carbide
(By kind permission of Professor G. I. Finch, Imperial College, London.)

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RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

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Non-destructive testing
ndustrial radiography
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Amplifiers
Radiocommunication
Mechanical engineering
Illumination
Metallurgy

LIST OF JOURNALS

The following list supplements that published with the Index Number of Vol. 53 (1950). Journals marked * are not received regularly though abstracts of articles from them are occasionally published. The addresses given are believed to be correct, but no responsibility can be accepted for errors.

An. Inst. Ing. Chile	*Anales del Instituto de Ingenieros de Chile.* Santiago.
Ann. Acad. Sci. Fennicae, Ser. A I.	*Annales Academiae Scientiarum Fennicae, Series A I. Mathematica-Physica.* Helsinki.
**Bull. Soc. Vaud. Sci. Nat.*	*Bulletin de la Société Vaudoise des Sciences Naturelles.* F. Rouge & Cie, Librairie de l'Université, Lausanne.
Canad. Stand.	*Canadian Standards.* National Research Building, Ottawa.
Chem. Engng News	*Chemical and Engineering News.* The American Chemical Society, 20th and Northampton Streets, Easton, Pennsylvania.
Elect. Engr Merch.	*Electrical Engineer and Merchandiser.* Tait Publishing Co. Pty, Melbourne.
**Gaz. Mat., Bucuresti*	*Gazeta Matematica, Bucuresti.* [Abstracted by *Mathematical Reviews.*]
Glasers Ann.	*Glasers Annalen.* Georg Siemens Verlagsbuchhandlung, Nollendorfstr. 28, Berlin W. 30.
Istanbul Univ. Fen. Fak. Mec. Ser. A.	*Istanbul Universitesi Fen Fakultesi Mecmuasi* [*Revue de la Faculté des Sciences de l' Université d'Istanbul*]. Seri A. Matematik-Fizik-Kimya. Büyük Reşit Paşa caddesi, Beyazit-Istanbul, Turkey.
J. Coll. Sci.	*Journal of Colloid Science.* Academic Press, 125 East 23 Street, New York 10, New York.
**J. Fac. Sci. Tokyo Univ.*	*Journal of the Faculty of Science.* University of Tokyo.
Koll. Zh.	*Kolloidnyi Zhurnal.* [Abstracted by *British Rheologists' Club Bulletin.*]
Mém. Soc. Roy. Sci. Liège.	*Mémoires de la Société Royale des Sciences de Liège.* L'Université, 7 Place du 20 Août, Liège.
**Mém. Soc. Vaud. Sci. Nat.*	*Mémoires de la Société Vaudoise des Sciences Naturelles.* F. Rouge & Cie, Librairie de l'Université, Lausanne.
Mon. Not. Astr. Soc. S. Africa.	*Monthly Notices of the Astronomical Society of South Africa.* The Royal Observatory, Cape, South Africa.
**Pap. Mkr*	*Paper Maker.* [Abstracted by *British Rheologists' Club Bulletin.*]
**Pulp Pap. Mag. Can.*	*Pulp and Paper Magazine of Canada.* [Abstracted by *British Rheologists' Club Bulletin.*]
Rev. Fac. Sci. Univ. Istanbul	*Revue de la Faculté des Sciences de l'Université d'Istanbul.* See under *Istanbul Univ. Fen. Fak. Mec. Ser. A.*
**Sheet Metal Ind.*	*Sheet Metal Industry.* [Abstracted by *British Rheologists' Club Bulletin.*]
**Smithsonian Rep.*	*Smithsonian Report.* The Smithsonian Institution, Washington, D.C.
**Stahl u. Eisen.*	*Stahl und Eisen.* [Abstracted by Metropolitan-Vickers Electrical Co.]
**Uchen. Zap. Mosk. Gos. Univ. Mekh.*	*Uchenie Zapiski Mosk. Gos. Univ. Mekhanika.* [Abstracted by *Applied Mechanics Reviews.*]

ORIGINAL ARTICLES

It is regretted that the articles from which abstracts are made cannot be sent out on loan. Application should be made to appropriate lending libraries or to the publisher of the Journal concerned; publishers' addresses, where known, are given in the "List of Journals" published with the January Number of Vol. 53 (1950), or in the supplementary lists published subsequently.

ERRATA

Abstr. 1509 (1949), line 2: *insert* Burg, A. B.

Abstr. 3087 (1949), line 2: *for* Herman, M. L. *read* Herman, L.

Abstr. 3285, line 2: *for* Huxley, L. H. G. *read* Huxley, L. G. H.; line 3: *for* **169** (No. 1064) *read* **196** (No. 1046).

Abstr. 4298 (1949), line 2: *for* Kuiper, G. F. *read* Kuiper, G. P.

Abstr. 1752 (1950) line 4: *for* $BrTiO_3$ *read* $BaTiO_3$.

Abstr. 1806 (1950) line 2: *for* Hawkins, R. C. *read* Hawkings, R. C.

Publications

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METEOROLOGICAL FACTORS IN RADIO-WAVE PROPAGATION

Report of a Conference held jointly by the Physical Society and the Royal Meteorological Society, 1946.

REPORT OF INTERNATIONAL CONFERENCE ON FUNDAMENTAL PARTICLES (Vol. I) and LOW TEMPERATURES (Vol. II), Cambridge, 1946

THE EMISSION SPECTRA OF THE NIGHT SKY AND AURORAE

Papers read at an International Conference held under the auspices of the Gassiot Committee, London, July, 1947.

THE STRENGTH OF SOLIDS

Report of Conference, Bristol, July, 1947.

RESONANT ABSORBERS AND REVERBERATION

Report of the 1947 Summer Symposium of the Acoustics Group of the Physical Society.

NOISE AND SOUND TRANSMISSION

Report of the 1948 Summer Symposium of the Acoustics Group of the Physical Society.

Prices will be supplied on application.

Reduced prices are allowed to members of the Physical Society on all the above publications.

THE PHYSICAL SOCIETY,

1 Lowther Gardens, Prince Consort Road, London, S.W.7.

MATHEMATICS 51

517.63

2844. The Laplace transform as a form of curve itting. H. M. TRENT. *Amer. J. Phys.*, **17**, 507–10 *Nov.*, 1949).

An explanation of curve fitting for physicists. To epresent analytically an arbitrary function over a inite interval, *I*, select a set of basic functions, each onsisting of an exponentially decaying or expanding inusoid. Take a sum of these. Formulae for com- uting the coeffs. are developed and these are simple nd compact, even when *I* becomes infinite. The onnection, in the latter case, with the Laplace ransform is pointed out. L. S. GODDARD

517.63 : 621.3.011.1

2845. The Laplace transformation and the study of ransient phenomena. S. COLOMBO. *Ann. Télé- ommun.*, **4**, 233–49 (*July*, 1949) *In French.*

A continuation of previous work [Abstr. 3777 1949)]. The use of the Laplace transform in the ymbolic calculus of Carson–Van der Pol is explained. Various contour integrals are evaluated and a table f Laplace transforms is given. The solution of artial differential equations by transform methods s illustrated by solving the telegraphic equation, and Maxwell's equations. The solution of integral quations and various asymptotic developments are iscussed. L. S. GODDARD (R)

518 : 311 : 621.3.012

2846. Graphical statistical methods. W. R. HIN- ON. *Wireless Engr*, **26**, 400–8 (*Dec.*, 1949).

The paper aims to provide the beginner with owerful statistical tools and techniques for examining lata graphically, and to direct the attention of those lready using Probability Paper to the quality of fit equired before an assumption of normality is ustified. Graphical methods are described which equire no theoretical knowledge of statistics, and the atural development of a conception of a "Normal opulation," and the evolution of Probability Paper, s described in simple terms; sufficient information is iven to prevent errors due to incorrect plotting. he examples have been chosen to be diverse, to mphasize the wide range of problems to which tatistical methods can be applied. A.

518.5

2847. Mechanical solution of diophantic problems. . NEMES. *Publ. Univ. Tech. Sci., Budapest* (*No.* 1) 9–50 (1949).

An electromechanical machine is described for olving systems of diophantine equations, and roblems similar to those arising in the game of chess. he possibilities of the machine are explored in ome detail. L. S. GODDARD

518.5

2848. A small differential analyzer with ball carriage ntegrators and Selsyn coupling. R. E. MEYEROTT ND G. BREIT. *Rev. Sci. Instrum.*, **20**, 874–6 (*Dec.*, 949).

518.5

2849. An application of resistance networks to the problem of adjustment by least squares. A. H. COOK. Letter in *Nature, Lond.*, **164**, 1088–9 (*Dec.* 24, 1949).

Adjusting levelling or similar observations involves solving a set of normal equations. Relaxation is a suitable method. Finding the weights of the adjusted results involves inverting the matrix of the normal equations. A sufficiently accurate inverse can be found from a network using C resistors of commercial accuracy. S. MICHAELSON

518.5

2850. A relay machine for the demonstration of symbolic logic. W. MAYS AND D. G. PRINZ. Letter in *Nature, Lond.*, **165**, 197–8 (*Feb.* 4, 1950).

518.5 : 548.735.44

Methods and apparatus for multi-dimensional Fourier synthesis. *See Abstr.* 3522

518.5 : 621.318.24 : 621.318.572

2851. Static magnetic storage and delay line. AN WANG AND W. D. WOO. *J. Appl. Phys.*, **21**, 49–54 (*Jan.*, 1950).

519.2 : 537.3 : 621.3.018

2852. The fluctuation process as vibration with random amplitude and phase. V. I. BUNIMOVICH. *J. Tech. Phys., USSR*, **19**, 1231–59 (*Nov.*, 1949) *In Russian.*

The method is a modification of the general method of solving non-linear transformation problems of signals with noise. The fluctuation potential $U = E\cos\phi$, representing a stationary random process, behaves like a sinusoidal vibration ($E_m\cos\omega t$) for which amplitude and phase vary. E and ϕ can be determined so that they represent definite statistically independent random quantities, varying slowly with time. If V is a different random process where $E = (U^2 + V^2)^{\frac{1}{2}}$, $V = E\sin\phi$, it is convenient to take V as determined by an integral in a certain finite time interval. This is connected with the range of the Fourier series representing U in that interval. If V and U are Gauss processes they are, at the same instant, statistically independent, from which independence of phase and amplitude follows. Density distribution of probabilities of amplitude and phase are also derived. J. JACOBS

519.24

2853. The application of multiple factor analysis to industrial test data. R. HARPER, A. J. KENT AND G. W. SCOTT BLAIR. *Brit. J. Appl. Phys.*, **1**, 23–8 (*Jan.*, 1950).

This technique is outlined and its relevance to problems of industrial physics is discussed. In particular, the method is applied to the analysis of a set of rheological and electrical tests on a set of plastics. 3 "factors" are sufficient to account for all the observed relationships between 10 tests. 3 numerical solutions have been evaluated, one involving non-orthogonal "factors" presenting the simplest solution for interpretation. All the solutions are linear transformations of one another. A.

519.24

2854. Note on the interpretation of multiple factor analysis. A. J. KENT. *Brit. J. Appl. Phys.*, **1**, 28–9 (*Jan.*, 1950).

The analysis of the preceding Abstr. shows that the tests described therein each measure some combination of 3 fundamental factors, each factor representing a property or quasi-property of the material. This note indicates one way in which this knowledge may be developed, the vector model being interpreted in terms of current ideas on high-polymer molecules. These lead to considerations of the grouping of the vectors of the vector model which indicate that the two most important factors may be the freedom of rotation of the C–C polymer chain linkages and the polar nature of the plasticizers. This conception is shown to agree with the whole structure of the vector model. A.

519.21

2855. Experimental designs balanced for the estima tion of residual effects of treatments. E. J. WILLIAM *Aust. J. Sci. Res. A*, **2**, 149–68 (*June*, 1949).

The designs are applicable where successive trea ments can be applied to the same unit of exper mental material. Results need adjustment for th residual effects of previous treatments. Methods ar described for constructing: (1) designs balanced fc effect of single preceding treatment; (2) design balanced for the effects of any number of precedin treatments, ignoring interaction; (3) designs balance for the effect of 2 preceding treatments and the interactions. The designs are developed from Lati squares. L. S. GODDAR

519.27

2856. Orthogonal polynomials in the least square fitting of observations. P. G. GUEST. *Phil. Mag.*, **41** 124–37 (*Feb.*, 1950).

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.1

2857. Survey of the year's work at the Mount Wilson and Palomar observatories. I. S. BOWEN. *Publ. Astr. Soc. Pacif.*, **61**, 243–53 (*Dec.*, 1949).

522.855 : 551.593.9

On the contribution of the extragalactic nebulae to the intensity of the night sky light. *See Abstr.* 3601

523.11

2858. Five dimensional cosmology. P. JORDAN. *Astr. Nachr.*, **276**, 193–208 (1948) *In German.*

A summary of investigations by the author and his collaborators on 5-dimensional projective relativity. The extension of Veblen's projective relativity is reviewed, and the physical interpretation of the mathematical relationships are discussed. An invariant, J, is interpreted as a scalar function of the field, and the possibility of its "variation" provides a precise basis for Dirac's idea of the variation of the gravitational constant with time. To obtain a closed universe the field equations of projective relativity must be modified. This is discussed. The problem of stellar evolution is studied.

MATHEMATICAL REVIEWS

523.11

2859. Note on rotational universe. C. Y. FAN. Letter in *Phys. Rev.*, **77**, 140 (*Jan.* 1, 1950).

It is noted that Gödel's model [Abstr. 702 (1950)] implies an increase in angular momentum with expansion. R. A. NEWING

523.112

2860. The distribution of the galaxies and the cosmological structure of space-time. A. GIÃO. *C.R. Acad. Sci., Paris*, **229**, 981–2 (*Nov.* 14, 1949) *In French.*

From a discussion based on the author's expression for the cosmological constant [Abstr. 697 (1950)], it is concluded that, on the cosmological scale, space-time cannot be considered as pseudo-Euclidean. The variation of mean curvature with expansion is found to be very small. R. A. NEWING

523.12 : 530.11

2861. Development of the universe. R. O. KAPP Letter in *Nature, Lond.*, **165**, 68 (*Jan.* 14, 1950).

Difficulties arising from the continuous creatio theories of Hoyle and of Jordan are discussed. Th creation process could be of infinite duration withou implying the formation of nebulae of infinite size if creation were accompanied by a continuou disappearance of matter. R. A. NEWIN

523.12 : 530.11

2862. Development of the universe. F. HOYLE Letter in *Nature, Lond.*, **165**, 68–9 (*Jan.* 14, 1950).

In reply to Kapp's criticisms (preceding Abstr.) it is pointed out that in the author's cosmolog nebular condensations of increasing age and siz occur at increasing distances, very old nebula becoming optically unobservable. Kapp's suggeste disappearance of matter is criticized as implying tha a star would lose $\frac{1}{2}$ its mass in 10^9 yr. Objections ar also raised to Jordan's theory of the sudden creatio of stars as supernovae. R. A. NEWIN

523.16

2863. The position and probable identification o the source of galactic radio-frequency radiatio Taurus-A. J. G. BOLTON AND G. J. STANLEY. *Aust. J. Sci. Res. A*, **2**, 139–48 (*June*, 1949).

Full details are given of observations using th "Lloyd's Mirror" technique [Abstr. 15 (1949)] an of reductions (including refraction corrections) whic lead to a position R.A. 5 h 31 m 20 s ± 30 s Dec 22° 02′ ± 8′, and an equivalent emitting strip width of $< 6'$. These limits enclose the Crab nebul *NGC* 1952, optical dimensions $4' \times 6'$. Comparison of effective temp. with Baade's and Minkowski' spectrographic observations and analysis of th nebula suggest a non-thermal origin for a componen of the radio emission. M. W. OVENDE

523.4

2864. The brightness of the zodiacal band and th total mass of asteroidal matter. V. G. FESENKOV *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 2) 149–52 (1949 *In Russian.*

523.5 : 551.510.535

2865. Meteor ionization in the upper atmosphere. A. C. B. LOVELL. *Sci. Progr.*, **38**, 22–42 (*Jan.*, 1950).

Review of techniques and most recent results. 32 refs.

523.673

2866. The spectrum of the tail of Cunningham's comet [1940 C, 1941 I]. P. SWINGS AND H. SAUVENIER. *Bull. Acad. Roy. Belge Cl. Sci.*, **35** (*No.* 11) 931–7 (1949) *In French.*

523.7 : 537.591.5

On the low energy spectrum of primary cosmic radiation and the sun's magnetic dipole moment. *See Abstr.* 3244

523.71

2867. Secular change in the mass of the sun. V. G. FESENKOV. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 6) 795–7 (1949) *In Russian.*

523.72

2868. Solar radio-frequency radiation of thermal origin. J. L. PAWSEY AND D. E. YABSLEY. *Aust. J. Sci. Res. A*, **2**, 198–213 (*June*, 1949).

Throughout the wavelength range 1 cm to 4 m the solar noise is shown to have a constant component, although strong variable components appear at the higher frequencies. A critical analysis of available observations shows that this component has the characteristic of random noise, is randomly polarized, and has an apparent temp./wavelength relationship in reasonable agreement with the predictions of Martyn [Abstr. 1746 (1948)] of thermal coronal and chromospheric emissions. Black body temps. vary from 10^6 °K at 1·5 m to 10^4 °K at 1·25 cm, a direct confirmation of a coronal kinetic temp. of about 10^6 °K. M. W. OVENDEN

523.72

2869. Bursts of solar radiation at metre wavelengths. R. PAYNE-SCOTT. *Aust. J. Sci. Res. A*, **2**, 214–27 (*June*, 1949).

Observations of the variable component of solar noise at frequencies of 85, 65, 60 and 19 Mc/s show two distinct types of variation, the "enhanced level" being circularly polarized, the other type being "unpolarized bursts." The latter are studied in detail. Over a range of frequencies they show differences of shape and amplitude but occur nearly simultaneously. Time-delays between extreme frequencies of the range are of the order of 1 sec, the bursts arriving in order of decreasing frequency. They decay exponentially, the decay constant being identified with the collision frequency at heights of origin in the solar atmosphere of $\sim 5 \times 10^5$ km; such sources would be above the echoing region, and the frequent occurrence of double maxima is attributed to the reflection of a primary pulse at lower coronal levels. Unpolarized bursts show a good correlation with fade-outs and major flares, but a poor correlation with minor flares. M. W. OVENDEN

523.72

2870. The noise-like character of solar radiation at metre wavelengths. R. PAYNE-SCOTT. *Aust. J. Sci. Res. A*, **2**, 228–31 (*June*, 1949).

Enhanced solar radiation at 85 and 60 Mc/s was compared with a C.W. signal and receiver noise. The solar emission was found to be indistinguishable from the noise of the receiver, whose bandwidth was 1½ Mc/s. M. W. OVENDEN

523.72 : 551.510.535 : 621.396.812

2871. Solar noise and ionospheric fading. R. L. SMITH-ROSE. Letter in *Nature, Lond.*, **165**, 37–8 (*Jan.* 7, 1950).

Note on the simultaneous observation on May 21, 1948, of a short-wave radio fade-out, a burst of solar radio noise (30 Mc/s) together with an amplitude and phase change in the ionospheric wave received from a station at a distance of 975 km on a frequency of 191 kc/s. The l.f. anomaly and the h.f. fade-out commenced some 5 min before the burst of solar noise. W. J. G. BEYNON

523.72 : 551.594.5

The aurora spectrum and the nature of exciting solar particles. *See Abstr.* 3608

523.746

2872. On the mathematical characteristics of sunspot-variations. A. F. COOK. *J. Geophys. Res.*, **54**, 347–54 (*Dec.*, 1949).

The fit attained using only two parameters is investigated. The observed data used are the smoothed monthly relative numbers and maxima and minima thereof. New relations among the observed data were found, first between the zero moment and the height of maximum, and second between the height of maximum and the time from start of the outburst to the epoch of centroid. A family of curves has been computed by applying these relations to Stewart and Panofsky's formula. The new family of curves thus found are deficient in two respects. First, for high cycles there may occur a bulge on the declining branch of the curve. Second, for low cycles it was found that the observed curves tend to run high on the ascending and descending branches and low in the middle. A.

523.747

2873. The visibility function of solar faculae. M. WALDMEIER. *Z. Astrophys.*, **26** (*Nos* 2–3) 147–57 (1949) *In German.*

523.75

2874. The variation of monochromatic total emission of the solar corona in the 11-year cycle. I. The line 5 303 Å. M. WALDMEIER. *Z. Astrophys.*, **26** (*Nos* 2–3) 264–71 (1949) *In German.*

Observations of the total emission of the solar corona in the light of the line 5 303 Å during a complete cycle of solar activity (1939–49) are dealt with. The total emission follows up the well-known variations of sunspot activity, the max. and min. coinciding very closely with that of the sunspot-numbers. During the maximum-year 1947 the total emission was 5 times > during the minimum-year 1944. A.

523.75

2875. The eruption-indicator. M. WALDMEIER. *Z. Astrophys.*, **26** (*Nos* 2–3) 205–12 (1949) *In German.*

A description of an instrument to indicate the sudden occurrence of chromospheric eruptions. The apparatus depends on the fact that the number of disturbances observed on long-wave radio reception increases suddenly at the moment of the outbreak of solar eruptions. A.

523.75 : 551.510.535

2876. A new theory of solar eruptions and the sudden disturbances caused by them in the *D*-layer of the ionosphere. I. S. SHKLOVSKIĬ. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 1) 37–9 (1949) *In Russian.*

523.76

2877. A tentative model of the sun. R. H. WOODWARD. *J. Geophys. Res.*, **54**, 387–96 (*Dec.*, 1949).

Owing to the non-uniform rotation of the photosphere in the solar magnetic field, a high potential-difference is established on the surface of the sun between the poles and the equator. Since at high altitudes electrons are free to travel between the polar and equatorial regions without cutting lines of magnetic force, a large vertical potential-gradient is developed at low and intermediate latitudes. The intense heat and visible and u.v. light of the chromosphere are considered to result from the outward flow of electrons through the reversing layer and chromosphere where excitation and ionization by bombardment take place. The rate of flow, and therefore the intensity of u.v. light, which controls the ion-density of the ionosphere, depends on sunspot-activity. The occasional electrical breakdowns of the solar atmosphere are thought to cause streams of electrons and negative ions to be ejected from the photosphere; these are observed as prominences. Positively charged gaseous material is drawn along the electron streams from coronal space to the centres of attraction in the photosphere. The cooling and magnetism of sunspots and the associated radiation of r.f. energy are considered to arise from the sustained outward flow of electrons from the photosphere. A.

523.77

2878. The spectrum of protuberances and chromospheric eruptions in the region 4 900–6 700 Å. M. WALDMEIER. *Z. Astrophys.*, **26** (*Nos* 2–3) 305–12 (1949) *In German.*

From a study of the spectra of prominences and flares in the region 4 900–6 700 Å a table is deduced containing the wavelength and identification of 93 emission lines, most of them observed for the first time in solar prominences. A.

523.77

2879. Line-broadening in solar flares. N. R. RAO, A. K. DAS, H. ANANTHAKRISHNAN, K. C. A. RAHEEM AND K. SETHUMADHAVAN; M. A. ELLISON. Letters in *Nature, Lond.*, **164**, 964–5 (*Dec.* 3, 1949).

Simultaneous observations of a flare emission with a prominence spectroscope and a spectroheliioscope gave effective line-widths of 8 Å for Hα, and 6 Å for Hβ. The inference that the observations are inconsistent with both Stark and Zeeman broadening is criticized by Ellison on the grounds that the effective line-width is a poor measure of true width of emission lines because of blending with the Fraunhofer absorption profiles. M. W. OVENDEN

523.77 : 551.510.4

2880. Atmospheric HDO. H. A. GEBBIE, W. R. HARDING, C. HILSUM AND V. ROBERTS. Letter in *Phys. Rev.*, **76**, 1534 (*Nov.* 15, 1949).

An absorption at 3·67 μ corresponding to the *Q*-branch of ν_1 HDO has been observed in solar spectra. M. W. OVENDEN

523.83

2881. Stellar rotation and age. D. TER HAAR *Astrophys. J.*, **110**, 321–8 (*Nov.*, 1949).

Various mechanisms for reducing the rotation of an originally fast-rotating star are considered. It is found that the only one which will probably influence the stellar rotation appreciably is the interaction between the magnetic field, owing to the dipole moment of the star, and the Strömgren *H* II region produced in interstellar gas clouds by stellar radiation. This mechanism has previously been considered by Alfvén. In the model investigated, the ratio of the loss of angular momentum per unit time to the total angular momentum is $\propto$ the square root of the radius of the *H* II region. The total loss of angular momentum is then given by the loss per unit time multiplied by the age of the star considered, or the age of the universe, whichever of these two is smaller. It then turns out that the young stars, like those of types *O* and *B*, will not have lost nearly so large a fraction of their angular momentum as will the late-type stars. A.

523.841

2882. A light curve for the magnetic variable star *HD*125248. D. W. N. STIBBS. Letter in *Nature, Lond.*, **165**, 195 (*Feb.* 4, 1950).

523.842

2883. Periods and eccentricities of close binary stars. K. WALTER. Letter in *Nature, Lond.*, **164**, 1129–30 (*Dec.* 31, 1949).

From data in the Fifth Lick Catalogue [L.O.B. 52 (1948)] a relationship is found between period and eccentricity for close pairs whose primary component lies on the main sequence. In general, for any spectral type of primary component, there are 2 distinct branches, that of high eccentricity decreasing in importance when proceeding to later type and non-existent for types later than *F*7. From pairs with which both spectra are observable, a systematic difference in average mass between the 2 branches is indicated. M. W. OVENDEN

523.852.22

2884. Recent results and state of planetary nebula research. II. K. WURM. *Naturwissenschaften*, **36** (*No.* 10) 306–12 (1949) *In German.*

Examines the central stars of the planetary nebulae, discusses the spectra of the nuclei, and analyses the determination of their temp. with Zanstra's method (by Ambarzumian, Berman, Wurm and Zanstra), and of their absolute magnitudes. Additional notes deal with the velocity distribution of the free electrons in the nebulae, and with the unique structure of the Crab Nebula which has been identified with the remains of the supernova of 1054 A.D., and whose central star has a temperature probably $\geqslant$ 100 000°. A. BEER

523.854.1

2885. Infrared observation of the galactic centre. A. A. KALINYAK, V. I. KRASOVSKIĬ AND V. B. NIKONOV. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 1) 25–8 (1949) *In Russian.*

523.873

2886. The spectrum of χ Cygni. M.-L. TCHENG. *C.R. Acad. Sci., Paris*, **229**, 1301–3 (*Dec.* 14, 1949) *In French.*

In pre-maxima spectra, absorptions due to the

olecules TiO, ZrO and ScO, 18 neutral and 6 ngly-ionized atoms were recognized. The line ii 3 905 Å, and the Balmer series from H_α–H_{20} with the exception of H_ε suppressed by Ca II H bsorption) were observed in emission. Differences etween these and Merrill's post-maxima spectra *Astrophys. J.*, **106**, 274 (1947)] are noted.

M. W. OVENDEN

523.873

2887. He II emission in the Wolf-Rayet binary star, Q Cephei. W. A. HILTNER. Letter in *Nature*, *ond.*, **165**, 194–5 (*Feb.* 4, 1950).

523.877

2888. Transfer problems in an atmosphere with ontinuous scattering and continuous absorption. . B. UNDERHILL. *Astrophys. J.*, **110**, 340–54 (*Nov.*, 949).

523.877

2889. On the broadening of hydrogen lines in stellar pectra. I. M. K. KROGDAHL. *Astrophys. J.*, **110**, 354–76 (*Nov.*, 1949).

Deals with the problem of how the Holtsmark listribution, which applies only to a static configura- ion of charged perturbing particles, must be modified n order to take into account the collision effect pro- luced by the motions of these particles. It is found hat, while the Holtsmark distribution describes the nigher members of the Balmer series quite well, cor- ections must be applied in order to discuss the broadening of $H\alpha$, $H\beta$, Lyman α, etc., in stellar atmospheres. A.

523.877

2890. The extent of the chromosphere of the *K*-type component of Zeta Aurigae. H. L. WELSH. *J. Roy. Astr. Soc. Can.*, **43**, 217–28 (*Nov.–Dec.*, 1949).

525.35

2891. On the rotation of the earth during its evolution. W. JARDETZKY. *Trans. Amer. Geophys. Un.*, **30**, 797–817 (*Dec.*, 1949).

525.722 : 612.84 : 551.593.12

The scintillation of stars. *See Abstr.* 2833, 3584

525.73 : 551.593.5

2892. Dependence of atmospheric extinction on wave-length. J. WEMPE. *Astr. Nachr.*, **275**, 1–22 (1947) *In German.*

The results of 18 spectral photometric extinction determinations in Jena under very different atmospheric conditions are given. The spectral gradients of the monochromatic extinction coeffs. show a high correlation with the extent of the visual extinction. The contribution of various factors to the extinction has been estimated. The effect of the scattering by molecules of the permanent gases in the atmosphere can be calculated by the Rayleigh theory; the selective absorption of O_3 in the Chappuis bands can be calculated from the thickness of the layer and the absorption coeff. The remainder of the extinction is due to H_2O vapour. For the Jena observations, the H_2O extinction follows the law $k_D = 1{\cdot}086\,\beta/\lambda^\alpha$, where α is 1·5 at Jena, but has different values at other places. BRITISH ABSTRACTS

526.7

2893. The gravity meter as a geodetic instrument. G. P. WOOLLARD. *Geophysics*, **15**, 1–29 (*Jan.*, 1950).

A special Worden temperature-compensated gravity meter having a range of 5 500 mgals, and a reading sensitivity of 0·1 mgal, was used to tie together various primary gravity base stations around the world and to establish new stations. 33 pendulum stations were reoccupied involving a change in gravity of 3 800 mgals, and 125 gravity stations were established. The investigation demonstrated that this instrument could be used satisfactorily for long-range geodetic work and the results appear to be the equal of good pendulum observations. Drift was corrected for on the basis of the drift rate established immediately before and after flights. Closures after correcting for drift averaged less than 0·4 mgals, and the closure for the world girdling loop was 0·33 mgals. The probable error based upon the gravity values at the reoccupied pendulum station was ±0·5 mgals. A.

526.72 : 550.312

The British submarine gravity surveys of 1938 and 1946. *See Abstr.* 3551

526.76 : 550.312

On the best dimensioning of the bifilar gravimeter. *See Abstr.* 3552

529.78

2894. Time and its astronomical definition. P. TARDI. *Ann. Franç. Chronom.*, **3** (*No.* 4) 347–63 (1949) *In French.*

The complex processes by which the unit of time is derived from astronomical observations is described. It is impossible to define the unit with the accuracy of 1×10^{-8} required by the radio engineer because of irregularities in the earth's rotation. If some other physical phenomenon could be used to define time intervals with the required accuracy it would benefit astronomy as well as other branches of physics.

L. ESSEN

529.78

2895. Observatory clocks and the measurement of time. A. DANJON. *Ann. Franç. Chronom.*, **3** (*No.* 4) 365–85 (1949) *In French.*

An account of the optical instruments, standard clocks and chronographs used at a large observatory for the determination of time and of the unit of time interval. L. ESSEN

PHYSICS 53

53.081.5

2896. A modern approach to "dimensions." P. MOON AND D. E. SPENCER. *J. Franklin Inst.*, **248**, 495–522 (*Dec.*, 1949).

The usual system of dimensions, in which the primary concepts are mass, length and time, is unsatisfactory because of ambiguity, e.g. capacitance and length, or resistivity and time, have the same dimension. Ambiguities still remain even when 2 additional primary concepts are introduced, one for

heat and another for electromagnetism. The trouble is the failure to distinguish between distances in different directions. 2 fundamental lengths, l_r and l_t (radial and tangential), are used to replace the usual l. This eliminates the ambiguity. There are 6 types of practical application for dimension theory and examples of these are given. L. S. GODDARD

53.081.6

2897. The "1947 values" of the atomic constants and the revision of the Faraday constant. J. W. M. DuMond. Letter in *Phys. Rev.*, **77**, 411 (*Feb.* 1, 1950).

FUNDAMENTALS 530.1

530.12

2898. The quantum theory of space-time. B. L. Averbakh (Auerbach) and B. V. Medvedev. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 1) 41–4 (1949) *In Russian.*

530.12

2899. The integrals of the motions of the centre of inertia of systems of finite masses in the general theory of relativity. I. G. Fikhtengolts (Fichtenholtz). *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 3) 325–7 (1949) *In Russian.*

530.12

2900. Electrical neutrality and the system of reference. H. Fetz. *Z. Naturforsch.*, **4a**, 625–7 (*Nov.*, 1949) *In German.*

This paper discusses the question of how electrical neutrality should be defined when the positive and negative charges have different velocities relative to the observer. It is suggested that neutrality should be defined as equality of the two charge densities in the systems in which they are respectively at rest.

P. M. DAVIDSON

530.12

2901. Gravitational fields of spherical symmetry and Weyl's conformal curvature tensor. XIII. V. V. Narlikar and K. P. Singh. *Phil. Mag.*, **41**, 152–6 (*Feb.*, 1950).

Solutions of the gravitational field equations of relativity are considered, so that the metric is non-static and has spherical symmetry, satisfying at the same time the additional equations, $C^h{}_{ijk,\,h} = 0$, where the tensor C_{hijk} is Weyl's conformal curvature tensor. The additional equations always hold good, whatever be the metric, when $R_{ij} = 0$, but when $R_{ij} \neq 0$ it is shown that the only spherically symmetrical solution of physical significance is what is known as Schwarzschild's internal solution. For the most general gravitational metric of spherical symmetry considered here, the condition $C_{hijk} = 0$ reduces to one equation only, which is one of those following from $C^h{}_{ijk,\,h} = 0$; and thus the corresponding space-time is conformal to flat space-time even when the latter condition alone is satisfied. A.

530.145

2902. The limits of the applicability of Sommerfeld's polynomial method in quantum theory. A. Rubinowicz. *C.R. Soc. Sci. Lett. Varsovie, Cl. III. Sci. Math. Phys.*, 57–63 (1947).

530.14

2903. The problem of vacuum polarisation. H. Umezawa, J. Yukawa and E. Yamada. Letter in *Progr. Theor. Phys.*, **3**, 317–18 (*July–Sept.*, 1948).

The self-energy of a photon due to interaction with a Dirac field and charged scalar (or pseudoscalar) mesons can be made to vanish, to order e^2, if the relative abundance of the Dirac and meson particles is 1 : 2. This scheme of interacting fields is not satisfactory, however, as not all 3 self-energies can be made finite even to this order of approx. When the 4th-order Compton effect is examined it is found that the meson field cancels some but not all of the divergent terms. G. J. KYNCH

530.14

2904. Theory of the interaction of elementary particles. IV. H. Umezawa, J. Yukawa and E. Yamada. *Progr. Theor. Phys.*, **4**, 25–33 (*Jan.–March*) 242 (*April–June*, 1949).

The detailed calculations of a letter previously published [Abstr. 2903 (1950); see also 1478 (1950)]. In a postscript it is noted that the calculation of the photon self-energy, based on ordinary perturbation theory and a simple subtraction procedure, has certainly to be reconsidered. A check by a newly devised relativistic perturbation theory is not satisfactory. An extensive list of errata appears in the second reference. G. J. KYNCH

530.144

2905. Note on the self-energy problem. K. Sawada, S. Takagi and M. Kobayasi. *Progr. Theor. Phys.*, **4**, 71–81 (*Jan.–March*, 1949).

In quantum electrodynamics, commutators of the potentials involve, in the interaction representation, two invariant singular functions D_0 and D_1, and two corresponding functions for the electron variables. Self-energy and vacuum polarization effects are connected with the D_1 functions, while the consistency of the fundamental equations and real processes to first order depend only on D_0 functions. Hence D_1 alone can be modified to give finite results without affecting consistency. Negative energy photons then appear. H. McMANUS

530.145

2906. Note on the formal solution of the Tomonaga-Schwinger equation. S. Tani. *Progr. Theor. Phys.*, **4**, 209–17 (*April–June*, 1949).

The unitary operator involved in the formal solution of the covariant electrodynamic equations, and the transformed interaction Hamiltonian density are expressed as power series in e, and recurrence formulae are given connecting the various orders.

H. McMANUS

530.145

2907. Gauge invariance and rest mass. K. J. Le Couteur. Letter in *Nature, Lond.*, **164**, 106 (*July* 16, 1949).

For the photon field interacting with electrons, etc., gauge invariance does not necessarily imply zero self-energy, as after elimination of virtual processes, vacuum photon equations may contain derivatives of field strength. However, photon self-energy obtained by Wentzel [Abstr. 445 (1949)] is not compatible with gauge invariance. H. McMANUS

530.145 : 537.122

2908. Semi-classical treatment of the reactive [radiative] corrections. I. The anomalous magnetic moment of the electron. Z. KOBA. *Progr. Theor. Phys.*, **4**, 319–30 (*July–Sept.*, 1949).

The error of sign in Welton's classical calculation of the anomalous magnetic moment [Abstr. 666 (1949)] is attributed to neglect of pair creation. Using the "trembler" model of Schrödinger which divides operators into a part commuting and a part which does not commute with the Hamiltonian, classical equations for these two parts of the co-ordinate x are obtained. This procedure gives the correct sign for the anomalous moment, and even numerical agreement with a cut-off at the Compton wavelength. It is pointed out that this device also furnishes the correct reduction factor for the scattering of slow electrons by a potential, due to negative energy states.

G. J. KYNCH

530.145

2909. Two-component wave equations. J. SERPE. Letter in *Phys. Rev.*, **76**, 1538 (*Nov.* 15, 1949).

Jehle's equation [Abstr. 5259 (1949)] may be used to describe Majorana's particles interacting with a pseudovector field. They may be extended to describe an interaction with a scalar and pseudoscalar field.

G. J. KYNCH

530.145

2910. On the limits of validity of Weizsäcker's method. G. MORPURGO. *Nuovo Cim.*, **6**, 504–18 (*Nov.* 17, 1949) *In Italian.*

The question is investigated of whether the Williams–Weizsäcker method can legitimately be applied to short range fields such as the meson field. In the case of an electromagnetic field it is concluded, by comparison with the Bethe–Heitler formulae, that the W.W. method is applicable when the Compton wavelength of the radiating particle is $\ll$ the range of the forces [see, e.g., Abstr. 1232 (1946)].

L. PINCHERLE

530.145

2911. On the formalism of quantized fields. J. PIRENNE. *Physica*, **15**, 1023–31 (*Dec.*, 1949) *In French.*

Gives a very simple method of obtaining the operators of fields quantized according to Bose–Einstein and Fermi–Dirac statistics, and bringing out clearly the meaning of the commutation relations. The passage from configuration space to quantum space is made by means of a unitary matrix S whose structure makes the quantized fields clear. One of the commutation relations arises from the fact that S must give a representation of the group of permutations: the other from the fact that S is unitary.

P. M. DAVIDSON

530.145

2912. Energy levels of a vector meson in a smeared Coulomb field. A. SIMON. Letter in *Phys. Rev.*, **76**, 1877 (*Dec.* 15, 1949).

The energy levels for extra-nuclear meson orbits are corrected for the finite size of the nucleus.

E. P. GEORGE

530.145

2913. Field dynamics. I. Classical. II. Quantum. K. V. ROBERTS. Letters in *Phys. Rev.*, **77**, 146–7 (*Jan.* 1, 1950).

530.145

2914. On the treatment of quantum electrodynamics without eliminating the longitudinal field. NING HU. Letter in *Phys. Rev.*, **77**, 150 (*Jan.* 1, 1950).

530.145

2915. The S-matrix for meson-nucleon interactions. P. T. MATTHEWS. *Phil. Mag.*, **41**, 185–95 (*Feb.*, 1950).

The possibility is considered of obtaining a divergence free S-matrix for the interactions of mesons with nucleons along the lines of mass and charge renormalization, which Dyson has successfully applied to quantum electrodynamics. It has been shown that this can be done for the vector interaction of neutral vector mesons. The procedure is here extended to the scalar interactions of scalar and pseudo-scalar mesons but proves to be quite inadequate to remove all the divergences in the other cases.

A.

530.145

2916. Longitudinal photons in quantum electrodynamics. F. J. DYSON. Letter in *Phys. Rev.*, **77**, 420 (*Feb.* 1, 1950).

530.145 : 537.12

2917. A self-consistent subtraction method in the quantum field theory. I. T. TAKI AND S. TOMONAGA. *Progr. Theor. Phys.*, **3**, 391–406 (*Oct.–Dec.*, 1948).

Using a many-time covariant formalism previously developed [*Progr. Theor. Phys.*, **3**, 208 (1948)], a canonical transformation from the interaction representation is carried through, which leads to a separation of the self-energy term. This is a subtraction, or renormalization, method in so far as the Hamiltonian of the free electrons can be augmented by a mass term which, when subtracted from the interaction, just cancels the self-energy term. A transformation is then given which separates a part of the radiation field, which is not bound to the electrons, and is therefore a generalization of that of Pauli and Fiertz.

G. J. KYNCH

530.145 : 537.12

2918. A self-consistent subtraction method in the quantum field theory. II. H. FUKUDA, Y. MIYAMOTO AND S. TOMONAGA. *Progr. Theor. Phys.*, **4**, 47–59 (*Jan.–March*, 1949).

Starting from the interaction representation [Abstr. 2917 (1950)] with an external field, the first-order radiation term (less the self-energy part) is changed by a canonical transformation to a second-order term. The various commutators of the external field are calculated as well, so that the corrections to electron scattering, Lamb–Rutherford shift, etc., can be obtained by inspection. The first part of their calculation is completed, using a plane basic surface in space-time.

G. J. KYNCH

530.145 : 537.533.74

2919. Reactive [radiative] corrections for the elastic scattering of an electron. S. ENDÔ, T. KINOSHITA AND Z. KOBA. Letter in *Progr. Theor. Phys.*, **3**, 320–1 (*July–Sept.*, 1948); errata, **4**, 100–1 (*Jan.–March*, 1949).

The radiative correction obtained by the self-

consistent subtraction or "renormalization" method [*Progr. Theor. Phys.*, **2**, 215 (1947)] is negative for small electron momenta p. If the alternative method is used of including a subsidiary meson field to remove divergences the correction is negative for very small p but positive for $p > (m/10)$. An erratum states that when mass renormalization is properly included the correction is amended. The conclusion is that the c meson field has a negligible effect. G. J. KYNCH

530.145 : 538.3

2920. A new conception of the interaction between charged particles and the electromagnetic field. L. DE BROGLIE. *Portugal. Math.*, **8** (*No.* 1) 37–58 (1949) *In French.*

A more complete exposition of the ideas mentioned in an earlier letter [Abstr. 242 (1950)]. G. J. KYNCH

530.145 : 538.3

2921. Reciprocity theory of electrodynamics. M. BORN, K. C. CHENG AND H. S. GREEN. Letter in *Nature, Lond.*, **164**, 281–2 (*Aug.* 13, 1949).

The reciprocity theory predicts the Lagrangian of the electromagnetic field. If the electron is considered as a singularity in the field, its energy and momentum are found to be finite. The theory can be reduced to Hamiltonian form for quantization. No divergencies occur in virtual transitions. Real processes are affected to a small degree which might be checked experimentally. H. MCMANUS

530.145.6

2922. Solution of the system of integral equations in Dirac's one-electron problem in momentum representation. A. RUBINOWICZ. *C.R. Soc. Sci. Lett. Varsovie, Cl. III, Sci. Math. Phys.*, 8 *pp.* (1949).

530.145.6

2923. Note on the wave-equation in the non-localizable system. H. SUZUKI. Letter in *Progr. Theor. Phys.*, **4**, 394 (*July–Sept.*, 1949).

General commutation relations between co-ordinates and momenta, x and p, and the electromagnetic field A_λ, are deduced from the defining equations of the non-localizable field [Abstr. 1456 (1950); also Markov, *J. Phys., USSR*, **2**, 453 (1940)]. G. J. KYNCH

530.145.6

2924. Field-mechanical wave equations for elementary particles with various spins. F. BOPP AND F. L. BAUER. *Z. Naturforsch.*, **4a**, 611–25 (*Nov.*, 1949) *In German.*

Bopp's field-mechanical derivation [Abstr. 1698 (1949)] of the Dirac wave equation for the electron is here generalized to obtain the wave equations of particles with other spins. P. M. DAVIDSON

530.145.6

2925. Reduced wave equations for elementary particles of half integral spin. F. L. BAUER. *Z. Naturforsch.*, **4a**, 720–1 (*Dec.*, 1949) *In German.*

Outlines a method of clarifying the wave equations of this type of particle by taking a linear sum of the wave components so as to obtain equations of simpler type. P. M. DAVIDSON

530.145.6 : 537.533.74

2926. A note on the variational method for the scattering problem. S.-S. HUANG. Letter in *Phys. Rev.*, **76**, 1878–9 (*Dec.* 15, 1949).

The variational principle formulated by Hulthén [Abstr. 3110 (1948)] is modified by dispensing with the auxiliary condition, the variational parameter and the phase shift η being determined from the condition $\delta L = k\delta\eta$, L being Hulthén's variation integral. The modified method, which is claimed to be more rigorous and simpler for computation, is illustrated by considering S-scattering by a Yukawa potential field. R. A. NEWING

530.145.6

2927. On the asymptotic distribution of eigenvalues. J. S. DE WET AND F. MANDL. *Proc. Roy. Soc. A*, **200**, 572–80 (*Feb.* 22, 1950).

530.163

2928. Classical statistical mechanics of a rectilinear assembly. F. GÜRSEY. *Proc. Camb. Phil. Soc.*, **46** (*Pt I*) 182–94 (*Jan.*, 1950).

The partition function, which is an analytic function of the temperature and pressure, is evaluated. All classical thermodynamical properties and the equation of state for an assembly of spherical molecules with short-range attractive forces between neighbours may be derived from this function. The linear model behaves like a perfect gas at high temperatures and like a crystal near absolute zero. At very low temperatures the slope of the isothermal curves can suffer very sharp changes which are interpreted as changes of phase. L. S. GODDARD

530.162 : 538.114 : 539.22

2929. Order-disorder statistics. II. A two-dimensional model. C. DOMB. *Proc. Roy. Soc. A*, **199**, 199–221 (*Oct.* 25, 1949).

Gives the detailed calculation of the partition functions for a 2-dimensional quadratic lattice from the matrix derived previously [see Abstr. 741 (1950)]. The method employed is the expansion of the eigenvector and eigenvalue as power series about zero temperature. It is found more convenient to deal with the general problem of an unsymmetric net with different interactions in the 2 directions; for a ferromagnetic in the absence of a magnetic field a symmetry relation observed empirically enables terms to be derived successively, and it is assumed that this solution is equivalent to Onsager's (1944). The method is applied in the presence of a magnetic field, and several terms of a generalized series are deduced. Several terms are hence obtained of a series for the spontaneous magnetization. An inspection of the generalized series leads one to conjecture that the specific heat curve becomes continuous in the presence of a magnetic field. Finally, the results are applied to the theory of binary solid solutions; the solubility curve for the 2 substances is formally closely related to the spontaneous magnetization. The separation into 2 phases is established, and the corresponding specific heat singularities are analysed. A.

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.252.2

2930. On the statics of the membrane. K. KONDO. *J. Soc. Appl. Mech. Japan*, **2** (*No.* 11) 119–22 (1949).

The concept of a curved 2-dimensional membrane in 3-dimensional space is generalized: a membrane is

regarded as any Riemannian sub-space of n dimensions in m-dimensional space. The internal stresses in the membrane form a symmetric 2nd-order tensor in the sub-space. In equilibrium, the divergence of the stress tensor vanishes, and the external normal pressure is related to the stress and curvature tensors for the membrane [see Abstr. 3436 (1950)].

J. G. OLDROYD

531.35

2931. On a question of stability relative to a problem of central motion with variable mass. E. MAGENES. *Comment. Pont. Acad. Sci.*, **12** (*No.* 5) 229–60 (1948) *In Italian.*

The differential equation $r''(t) = c^2/r^3(t) - f[r(t)]M(t)$ is studied, where c is a constant and f and M are given functions. Theorems are proved on various properties of its integrals. It is further proved that, if given restrictive conditions on f and M are satisfied, taken any two real numbers a, b $(a > 0)$, a unique solution exists for $0 < t < +\infty$ defined by $r(0) = a$, $r'(0) = b$, and that $\lim_{t \to +\infty} r(t) = 0$.

L. PINCHERLE

531.4 : 621.317.7.085.22

2932. Note on the frictionless bearing for small angular deflections. J. A. HARINGX. **Reply.** H. SCHLITT. Letters in *J. Appl. Phys.*, **21**, 258 (*March*, 1950).

531.55

2933. Plausible speed limit for metallic projectiles. K. R. DIXIT. *Indian J. Phys.*, **23**, 469–76 (*Nov.*, 1949).

An attempt to show that the max. speed attainable by a metal projectile in the atmosphere or in space is of the order of Mach 7.

MECHANICAL MEASUREMENTS 531.7

531.72

2934. Permeability studies. IV. Surface area measurements of zinc oxide and potassium chloride powders. J. C. ARNELL. *Canad. J. Res. A*, **27**, 207–12 (*Nov.*, 1949).

The use of the modified Kozeny equation for the measurement of the specific surfaces of fine powders has been extended to include a number of standard Zn oxides and a sample of KCl. The specific surfaces of the Zn oxides had been measured by 10 other methods, and the data are included for comparison. Comparative low temperature adsorption data for the KCl are also given. Satisfactory agreement with other methods was found. A.

531.731.4

2935. Determining densities and adsorption of gases by solids. R. E. BOEHLER AND T. ASON. *Analyt. Chem.*, **21**, 1568–70 (*Dec.*, 1949).

Details are given of an apparatus for the determination of the density of industrial powdered materials (such as cement) by measurements of the permeability to air of a column of the material. Air from a reservoir system S of definite volume is passed through the column and escapes to the atmosphere; the time required for the pressure in S to fall from p_2 to p_1 is registered automatically. Carrying out the determination first with, then without, the sample in position, the volume and thence the density of the sample can be calculated. About 1 l of sample is used. The procedure may be modified to apply to porous solids. S. J. GREGG

531.764.5

2936. On the use of crystal controlled synchronous motors for the accurate measurement of time. V. E. HOLLINSWORTH. *Canad. J. Res. F*, **27**, 470–8 (*Dec.*, 1949).

Making use of the quartz frequency standard of the Dominion Observatory crystal clock an electronic frequency converter has been constructed that transforms the 50 000 c/s output of the crystal to a frequency of 60 c/s. Suitable amplification makes possible sufficient power for operating several standard 60 c/s motors and these are being used to drive printing and drum chronographs and for the operation of other types of recorders. A.

531.78 : 535.551 : 620.179.1

2937. An optical method for measuring the stress in glass bulbs. W. T. READ. *J. Appl. Phys.*, **21**, 250–7 (*March*, 1950).

The basic principles of photoelasticity in 3 dimensions are applied to the case of a cylindrical shell. Theoretical results are verified experimentally for a tube in which the stress distribution is axially symmetrical. Experimental results on tubes in which the stress distribution was unsymmetrical lead to the conclusion that the maximum tensile stress $\propto$ the maximum retardation, the factor of proportionality being simply related to the form of the fringe pattern. A quick and simple technique is described for making the necessary optical measurements. A.

531.787.6

2938. Study of a thermal micromanometer, prefaced by some general remarks on this type of instrument. L. DUNOYER. *Vide*, **4**, 571–84 (*March*, 1949) *In French.*

The principle of the thermal micromanometer is described, and a historical survey of its various forms, including those of the author, Pirani, and Hale, is given. The deficiencies are pointed out, and the need to distinguish between the manometer's ability to detect small changes from an initial low pressure and its ability to measure pressure over a large range is emphasized. For the latter a stable zero is required, and such a manometer constructed by the author is described in detail. It is of the compensating type, with two bulbs containing straight W filaments connected in parallel to a balanced bridge. Calibration curves for air and H are given.

S. WEINTROUB

531.787.6

2939. Study of a thermal micromanometer. L. DUNOYER. *Vide*, **4**, 603–18 (*May*, 1949) *In French.*

An improved bridge wire is described and shown diagrammatically. Calibration curves for the micromanometer over the range 0–3 500 $\times 10^{-6}$ mm Hg pressure for various feed currents are given and discussed. Variation in ambient temp. has little effect. The sensitivity, the slope of the calibration curve, is constant for low pressure (initial sensitivity)

and then decreases. The initial sensitivity could be increased as much as 20 times, at the expense of zero stability, by the addition of equal resistances to the ends of the bridge wire, and a variation of 4×10^{-6} mm Hg then detected. The filament temps. were determined for feed currents of 150 and 250 mA. The range of usefulness, both for measurement of pressure variations and of pressure, and the precision attainable, are discussed. S. WEINTROUB

531.787.6

2940. Study of a thermal micromanometer. L. DUNOYER. *Vide*, **4**, 643–60 (*July–Sept.*, 1949) *In French.*

An expression is derived for the initial sensitivity [see also Abstr. 6005 (1949)]. The dependence of the initial sensitivity on the choice of filament and bridge-wire, the filament and wall temps., and the nature of the gas, and the agreement between theory and experiment are discussed. The most important factors are the length of the bridge wire, the initial temp. of the filament (i.e. under zero pressure) and the wall temp. From the experimental work a value of $6{\cdot}52\times10^{-6}$ in place of the accepted value $0{\cdot}7\times10^{-6}$ per °K² for the second temp. coeff. of resistance of W for 193–273°K is deduced. The case of non-zero initial pressure [see also Abstr. 753 (1950)], and the influence of variations in wall temp. on the measurement of pressure are also considered. S. WEINTROUB

MECHANICS OF FLUIDS 532

532.123 : 532.595

2941. Note on the damping of the rotational oscillation of a spherical mass of an elastic fluid in consequence of slipping along the boundary. J. M. BURGERS. *Proc. K. Ned. Akad. Wet.*, **52** (*No.* 2) 114–19 (1949).

Previous work [Abstr. 1715 (1949)] is continued. More accurate formulae are found for the period of oscillation and the logarithmic decrement, for an elastic fluid in a spherical vessel. Values obtained are compared with experimental values for systems having an oleate concentration of 0·6% [Abstr. 1714 (1949)]. L. S. GODDARD

532.13

2942. Some flow properties of concentrated high-polymer solutions. R. S. RIVLIN. *Proc. Roy. Soc. A*, **200**, 168–76 (*Jan. 6*, 1950).

A review of a theoretical investigation of the flow properties of fluids in which the assumptions underlying the classical hydrodynamics of viscous fluids no longer holds. For an incompressible visco-inelastic fluid—or visco-elastic fluid in steady-state laminar flow—the stress-strain-velocity relations involve two physical parameters which may or may not depend on the state of flow. One of these is the viscosity and the other the normal stress coeff. On a simple model of a concentrated high-polymer solution, it is shown that the normal stress coeff. may have an appreciable value. Finally, the manner in which the basic assumptions of the theory may be inapplicable to real concentrated high-polymer solutions is discussed. A.

532.13

2943. An electrical viscometer. A. R. BOYLE. *J. Sci. Instrum.*, **27**, 41–3 (*Feb.*, 1950).

A simple electrical viscometer has been designed enabling instantaneous indications of viscosities of liquids at any point in an industrial plant. The transmitter unit consists of a 2-phase electric motor operated from single-phase mains and so designed and constructed that large variations of current in one phase are produced by small changes in viscous drag on the rotating part. The indicator unit is essentially an ammeter in one of the motor phases and is directly calibrated in viscosity units. Models have been designed for operation within pipe lines and containers up to high pressures and temps. (about 250°C) and for rapid testing of samples. A.

532.

2944. The equilibrium of liquids. J. YVON. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 187–97 (1949) *In French.*

From certain assumed data regarding molecular constants, the paper reviews the possibility of arriving at the average equations of hydrodynamics—and hydrostatics—in accordance with fundamental theorems of Heisenberg and of Dirac. Results in the case of liquid He are not, however, satisfactory; additional fundamentals are required. G. GREEN

532.

2945. Variational principle and canonical equations of an ideal liquid. B. DAVIDOV. *Dokl. Akad. Nauk SSSR*, **69** (*No.* 2) 165–8 (1949) *In Russian.*

532.5

2946. Development of liquid motion due to an impulse. M. RAY. *Bull. Calcutta Math. Soc.*, **41** 179–82 (*Dec.*, 1949).

An impulse is suddenly applied in a plane to an infinite liquid, otherwise at rest. The equations of motion are solved, approximately, and some numerical tables, calculated from the formulae, show the velocity distribution at various times. A simple formula is derived for the thickness of the layer disturbed at any time. L. S. GODDARD

532.5

2947. The analogy between hydraulic jumps in liquids and shock waves in gases. F. R. GILMORE, M. S. PLESSET AND H. E. CROSSLEY, JR. *J. Appl. Phys.*, **21** 243–9 (*March*, 1950).

The theory of the hydraulic jump is presented briefly, and the analogy between this phenomenon and the compression shock wave in gases is pointed out. The results of experimental measurements on hydraulic-jump intersections on a water table are reported. Considerable disagreement between theory and experiment is found, unlike that found in the aerodynamic case. Possible reasons for the discrepancy in the hydraulic case are discussed; some sources of error are peculiar to hydraulic jumps and do not apply to compression shocks. Such factors limit the utility of the water table as an analogue device. A.

532.5

2948. A method for the numerical calculation of hydrodynamic shocks. J. VON NEUMANN AND R. D. RICHTMYER. *J. Appl. Phys.*, **21**, 232–7 (*March*, 1950).

The equations of hydrodynamics are modified by

the inclusion of additional terms which greatly simplify the procedures needed for stepwise numerical solution of the equations in problems involving shocks. The quantitative influence of these terms can be made as small as one wishes by choice of a sufficiently fine mesh for the numerical integrations. A set of difference equations suitable for the numerical work is given, and the condition that must be satisfied to ensure their stability is derived. A.

532.57 : 621.316.71

2949. The control of quantity and mixtures of gases and liquids by an integrating regulator. H. GARTHE. *Frequenz*, **3**, 353–63 (*Dec.*, 1949) *In German.*

In controlling the flow of liquids or gases it is necessary either to ensure that the quantity per unit time interval remains constant or follows a predetermined law. When mixtures are being made continuously, at least two such controls are necessary. The integrating controller may be driven by the rate of flow of the main stream and operate a valve to control the flow. The stability of such a regulator is considered theoretically, and negative feedback is also introduced. A. C. WHIFFIN

532.582

2950. On the axially symmetric flow around a new family of half-bodies. A. VAN TUYL. *Quart. Appl. Math.*, **7**, 399–409 (*Jan.*, 1950).

For the half-bodies see Weinstein [*Quart. Appl. Math.*, **5**, 429 (1948)]. An analytical and numerical study of these, and the corresponding velocity distributions is made. In all calculations the expressions for the stream function and velocity components are in terms of elliptic integrals. A set of graphs is given by means of which the nose of any given profile can be plotted, and representative profiles are shown. Curves showing the position and magnitude of the maximum velocity on the surface are also given.

L. S. GODDARD

532.582.2

2951. Rayleigh's problem for a semi-infinite plate. L. HOWARTH. *Proc. Camb. Phil. Soc.*, **46** (*Pt I*) 127–40 (*Jan.*, 1950).

The plate is thin and is immersed in a viscous incompressible fluid at rest. It moves impulsively with a velocity parallel to the edge. The problem solved is that of determining the subsequent motion of the fluid. Two solutions are given: (1) an infinite series, (2) a single integral. The former is convenient for numerical calculations near the edge. Steady flow past a quarter-plane whose leading edge is normal to the direction of flow is studied; and approximate expressions are obtained for the effect of the edges on the skin friction of a sufficiently broad rectangle whose length is parallel to the incident stream.

L. S. GODDARD

532.582.3

2952. The mechanics of large bubbles rising through extended liquids and through liquids in tubes. R. M. DAVIES AND G. TAYLOR. *Proc. Roy. Soc. A*, **200**, 375–90 (*Feb.* 7, 1950).

Describes measurements of the shape and rate of rise of air bubbles varying in volume from 1·5 to 200 cm³ when they rise through nitrobenzene or water. A.

532.582.4

2953. A new treatment of the ship-wave problem. A. S. PETERS. *Commun. Pure Appl. Math.*, **2**, 123–48 (*June–Sept.*, 1949).

The linearized problem is solved by a new method, which is such that complete asymptotic expansions for the solution can be derived by the method of steepest descents. The results are compared with those of Kelvin; and the method is compared with the recent one of Dean [Abstr. 228 (1947)]. The 3-dimensional case is also treated. L. S. GODDARD

532.59

2954. Mathematical solution of the problem of roll-waves in inclined open channels. R. F. DRESSLER. *Commun. Pure Appl. Math.*, **2**, 149–94 (*June–Sept.*, 1949).

Solutions, periodic with respect to distance, are found for describing "roll-waves" for water flow in a wide inclined channel. It is shown that no continuous solutions can be periodic, and only one special continuous solution can be used for constructing discontinuous periodic solutions. The analysis is based on the non-linear equations of the "shallow water theory." Shock conditions for an arbitrary channel and for flow with resistance are derived. The special continuous solution is obtained explicitly. Roll-waves cannot occur if the resistance is zero or exceeds a critical value. 12 sets of curves are given to illustrate the quantitative behaviour of roll-waves; these may be used to check the theory with observed data. There is a 1-parameter family of roll-wave solutions for prescribed values of slope, resistance and wave-speed. L. S. GODDARD

532.591

2955. The propagation of waves in shallow water. S. C. LOWELL. *Commun. Pure Appl. Math.*, **2**, 275–91 (*June–Sept.*, 1949).

The differential equation satisfied by the wave amplitude $\zeta(x, y, t)$ is replaced by an integral condition, which leads to useful results when amplitude jumps are permitted. These jumps must occur on certain characteristic surfaces. The intersections of such a surface, with the planes $t = \text{const.}$, give, upon projection on to the x, y-plane, a family of curves, called wave-fronts. The function describing these fronts is identical with Hamilton's eikonal equation of geometrical optics, provided the refractive index is replaced by $1/\sqrt{(gh)}$, where h is the depth. Various deductions from this equation are made. The problem of wave motions on a gently shoaling straight beach, with the bottom contours parallel to the beach, is studied in detail. It is of practical interest in the forecasting of surf and swell conditions. A variant of this problem, where the wave-number is not assumed to be large, is also considered.

L. S. GODDARD

CAPILLARITY 532.6

532.614

2956. Surface tension of small droplets from Volmer and Flood's nucleation data. V. K. LA MER AND G. M. POUND. Letter in *J. Chem. Phys.*, **17**, 1337–8 (*Dec.*, 1949).

532.64

2957. Contact angle of natural graphite. K. K. MAJUMDAR. *J. Sci. Industr. Res.*, **8B**, 232–4 (*Dec.*, 1949).

The contact angle, of a polished graphite surface, to distilled water was measured by observing the size and shape of air bubbles attached to the surface when it is immersed (face down) in water [see Abstr. 173 (1941)]. The contact angle varies from 17° 49′ to 25° 8′, increasing with the purity of the specimen.

J. IBALL

532.68 : 534.414

Mechanical resonance in freely falling raindrops. *See Abstr.* 3007

532.69

2958. Systems of mutually immiscible liquid layers. R. E. PATTLE. Letter in *Nature, Lond.*, **165**, 203–4 (*Feb.* 4, 1950).

MOLECULAR THEORY OF LIQUIDS 532.7

532.71

2959. Diffusion and membrane permeability. I. B. J. ZWOLINSKI, H. EYRING AND C. E. REESE. *J. Phys. Coll. Chem.*, **53**, 1426–51 (*Dec.*, 1949).

A new theory has been developed for the diffusion and permeability of membranes by considering molecular migration as a series of molecular jumps from one equilibrium position to another governed by a rate constant. A simple method has been developed for deriving Fick's first and second laws by considering difference equations. The theory is applicable to the diffusion of electrolytes and non-electrolytes in homogeneous and heterogeneous membranes, either in the presence or absence of external forces such as electrical fields, concentration gradients, or activity gradients. A.

532.72

2960. Interferometric study of diffusion in liquids. E. CALVET. *Rev. Opt. (Théor. Instrum.)* **29**, 35–40 (*Jan.*, 1950) *In French.*

Modified Young's fringes are used, the divided beams being sent respectively through a homogeneous liquid and for a similar path length through a liquid in which diffusion takes place vertically. Diffusion leads to fringe displacement. The method of evaluation is discussed. The technique is applied to measurements of diffusion of NaCl, sucrose, phenol, hydroquinone and ether in pure water. A new diffusion equation is proposed and this permits calculation of the Fick diffusion coefficient at zero concentration and zero gradient. The proposed equation contains van der Waals' terms as applied to a solution. The method described is applicable to the study of sedimentation, the diffusion of large molecules, and the determination of thermal conductivities of liquids. S. TOLANSKY

532.723

2961. On the mechanism of Brownian motion in liquids. F. J. BELINFANTE. *Amer. J. Phys.*, **17**, 468–76 (*Nov.*, 1949).

Einstein's law, for the mean square displacement of a spherical particle suspended in a liquid, is derived. The collision frequency is estimated and various other factors are discussed. It is pointed out that fluctuations in thermal collisions cannot be discussed statistically, without considering correlations between the velocities of the molecules at different places in the liquid. Reasons are given for the breakdown of Stokes's law for the friction in Brownian motion.

L. S. GODDARD

532.7

2962. On the theory of regular solutions. G. S. RUSHBROOKE. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 251–63 (1949).

Explains the close analogy between the theory of ferromagnetism (based on the Ising model) and the theory of regular solutions. For the latter, a detailed evaluation of the expressions which arise in the case of a cubic lattice has been attempted by Wakefield and a preliminary account of the results is given; the phase boundary curve is shown, and the value obtained for the maximum critical mixing temperature is compared with those given by the Bragg–Williams and Bethe–Guggenheim approximations.

P. M. DAVIDSON

532.73

2963. Solubility of water in hydrocarbons. J. H. HILDEBRAND. Letter in *J. Chem. Phys.*, **17**, 1346–7 (*Dec.*, 1949).

532.74 : 536.7

Some properties of van der Waals' liquids. *See Abstr.* 3134

532.74 : 536.7

2964. Reduced temperatures for the liquid state. General equations for the orthobaric densities as functions of the reduced temperature. A. F. SCOTT AND R. DILLON. *J. Chem. Phys.*, **17**, 1179–90 (*Dec.* 1949).

The reduced temp. θ proposed by Bauer, Magat and Surdin [*Trans. Faraday Soc.*, **81** (*Sept.*, 1936)] for the liquid state is presented and their work is reviewed. Attention is directed to the fact that a number of empirical power law equations that represent the variation of a property of a liquid as a function of the van der Waals' reduced temp. are directly transformable into analogous functions of θ. General equations are derived for the variation of the orthobaric liquid and vapour densities as function of the reduced temp. A.

MECHANICS OF GASES 533

533.15

2965. Thermo-osmosis of gases through a membrane. S. WELLER. Letter in *Nature, Lond.*, **165**, 198–9 (*Feb.* 4, 1950).

533.15 : 536.7

The thermal effect of diffusion in gases. *See Abstr.* 3135

533.21

2966. Gases with a pressure-density relation—impossibility of confocal density distributions. N. L. GHOSH. *Bull. Calcutta Math. Soc.*, **41**, 183–6 (*Dec.*, 1949).

The impossibility is proved for constant or variable angular velocity and the result is true for any gravitational field. No external boundary conditions are explicitly used. [For previous work see Abstr. 515, 5983 (1950)]. L. S. GODDARD

533.21

2967. Corrections to my paper on "An extension of Hamy's Theorem, etc." N. L. GHOSH. *Bull. Calcutta Math. Soc.*, **41**, 220 (*Dec.*, 1949).

[See Abstr. 1515 (1949)]. A conclusion regarding the spherical density-distribution of a uniformly rotating mass of gas is corrected. L. S. GODDARD

533.5

2968. A phenomenon connected with formation of absorbed layers. L. DUNOYER. *C.R. Acad. Sci., Paris*, **230**, 57–8 (*Jan.* 2, 1950) *In French.*

Practical evidence is quoted to show that there is a tendency for absorbed gases to travel along the inside of the glass surface of an evacuated apparatus. It is desirable to seal any metal parts into the tube as soon as possible after they have been de-gassed, unless a getter is used. N. CORCORAN

533.5 : 621.385.1.032.46

2969. An improved method of testing for residual gas in electron tubes and vacuum systems. E. W. HEROLD. *RCA Rev.*, **10**, 430–9 (*Sept.*, 1949).

Existing methods of test employ a negative electrode in the tube or in an ionization gauge to collect ion current, which is measured with a d.c. meter. Unfortunately, leakage and other stray direct currents are of the same nature so that ion currents below the stray level cannot be determined. The improved method described converts the desired ion current to a.c. by modulation of the ionizing electron stream while leaving the original undesired stray currents relatively unmodulated. Modulation is accomplished by a magnetic or an electric field and it is found that the chief undesired a.c. is now in phase quadrature with the desired ion current and can be reduced by choice of a low frequency and a phase-sensitive a.c. meter or by neutralization. The method permits 10^{-9} A to be measured without special precautions; neutralization of the quadrature undesired components improves the sensitivity to 10^{-11} A. Some applications of the method to conventional and special tubes are shown. A.

533.59

2970. Vacuum tight, flexible metal-glass seal. K. M. SANCIER. Note in *Rev. Sci. Instrum.*, **20**, 958 (*Dec.*, 1949).

533.6.011.5

2971. The supersonic flow of compressible fluid through axially symmetric tubes of uniform and varying section. R. K. TEMPEST. *Proc. Roy. Soc. A*, **200**, 511–23 (*Feb.* 22, 1950).

533.6.011.5 : 541.124

Sudden changes of compression produced at non-equilibrium chemical transformations in a supersonic gas stream. *See Abstr.* 3451

MOLECULAR THEORY OF GASES 533.7

533.72 : 536.633.3

Measurement of specific heats of a gas. *See Abstr.* 3133

533.73

2972. On the behaviour of a gas near a wall. H. A. KRAMERS. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 297–304 (1949).

The velocity of the gas on the face of the wall is assumed to be $u_0 = \zeta \partial u/\partial n$, where ζ is a constant and $\partial u/\partial n$ is the gradient normal to the wall. Here ζ is expressed in the form $\zeta = k\bar{l}$, where $\bar{l}$ is the mean free path, and estimates are made of the value of the constant, k. The analysis is based on Boltzmann's integro-differential equation satisfied by the velocity distribution. L. S. GODDARD

533.77

2973. On the statistical theory of first order phase changes. B. T. GEĬLIKMAN. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 3) 329–32 (1949) *In Russian.*

For arbitrary temperature T these phase changes are only possible if repulsive as well as attractive forces act between molecules. The horizontal portion of the p–v curve does not as has been customarily assumed correspond to equilibrium between liquid and gas phase. The assumed condensation point is a point of a third-order transition, which cannot arise if molecules repel each other at close distances either for high or sufficiently low T. J. JACOBS

VIBRATIONS . ACOUSTICS 534

534.01

2974. Some non-linear systems permitting simple harmonic motion. J. E. BROCK. *J. Appl. Phys.*, **21**, 238–43 (*March*, 1950).

By elementary and obvious methods a differential equation is obtained, which in general is non-linear and usually affords a solution which is a simple sinusoidal function of the independent variable (i.e. simple harmonic motion). Two particular examples are studied briefly although no physical realizations are presented. One is led to speculate that new types of oscillators having a sinusoidal output are described by these equations, and that practical applications, such as to frequency metering, may eventually be evolved. A.

534.015

2975. Determination of the frequencies and amplitudes of oscillations of coupled undamped elements. R. KOŠŤÁL. *Publ. Fac. Sci. Univ. Masaryk* (*No.* 300) 25 *pp.* (1948) *In Czech.*

The functions are discussed from which the general equations for n coupled elements can be deduced by means of the Lagrange equations; the equations of motion and the form of the functions are deduced for the case when each element is coupled only with both neighbouring elements. In addition to determining the frequencies of the resultant motions in the general case by the usual method of determinants,

another method is developed in which the equations of motion of the individual elements are obtained by linear transformation so that the k-th equation of motion contains only those values which affect the motion of the k-th element. Thus one obtains the relative values of the amplitudes of the original frequencies in the motion of the k-th element. Both these methods are modified to be applicable for the case of successive coupling (each element coupled only with its neighbouring elements). This method of transformations is applied for 2 elements coupled by acceleration and amplitude, 3 equal and n equal elements coupled successively by the amplitude (deflection). The number of the oscillation frequencies of the individual elements for $n \leqslant 9$ are also deduced. E. GROS

534.015

2976. The theory of the composition of two undamped oscillations by means of torsion pendulums. R. KOŠŤÁL. *Publ. Fac. Sci. Univ. Masaryk*, **21** (*No.* 1) 1–23 (1949) *In Czech.*

The author describes a method which can be applied for experimental graphical composition of two undamped oscillations. For this purpose two torsion pendulums are used, one pendulum being suspended on the other. These pendulums have the advantage that their oscillations are practically undamped and their frequency is not dependent on the amplitude. The conditions which must be fulfilled to obtain the oscillations of a predetermined frequency ratio are deduced, particularly those conditions at which the two torsion pendulums give the composite oscillations having the following ratios of the frequencies:

$$\tfrac{9}{8},\ \tfrac{6}{5},\ \tfrac{5}{4},\ \tfrac{4}{3},\ \tfrac{3}{2},\ \tfrac{8}{5},\ \tfrac{5}{3},\ \tfrac{9}{5},\ \tfrac{15}{8},\ 2$$

For the cases of the oscillations having the required ratio of the amplitudes and the required phase angle, the initial amplitudes and velocities of pendulums are given. E. GROS

534.11

2977. The analytical continuation of functions associated with linear physical systems. G. ZIN. *Nuovo Cim.*, **6**, 531–42 (*Nov.* 17, 1949) *In Italian.*

The response of a linear system to a purely sinusoidal excitation may be represented by $f(\omega) \exp(i\omega t)$. The present paper proves that, if the function $f(\omega)$ of the real variable ω has been determined at a finite number of points in an interval $\omega_1 < \omega < \omega_2$, its value at a point ω_0 external to the interval may be determined as the limit of a succession of integrals, even without any knowledge of the structure of the system, and the error may be made as small as desired by determining $f(\omega)$ at a sufficiently large number of points within the interval (ω_1, ω_2). L. PINCHERLE

534.152

2978. Employment of chemical reactions to obtain pictures of acoustic phenomena. H. RUST, R. HAUL AND H. J. STUDT. *Naturwissenschaften*, **36** (*No.* 12) 374–5 (1949) *In German.*

Ultrasonic vibrations will cause oxidation reactions in aqueous solutions containing air, and KI solution can be used to give a colour indication of the presence of such oxidation. A Plexiglas plate is covered with square chambers each 4 mm × 4 mm and 1 cm deep and filled with such a solution. When placed in a ultrasonic field, the intensity of the colour produce in each small cell indicates the intensity of th vibration. A. C. WHIFFI

534.2

2979. Application of vector analysis to the wav equation. W. J. CUNNINGHAM. Letter in *J. Acous Soc. Amer.*, **22**, 61 (*Jan.*, 1950).

534.2

2980. Ultrasonic absorption in liquids. G. W HAZZARD. *J. Acoust. Soc. Amer.*, **22**, 29–32 (*Jan* 1950).

The Debye–Sears method for measuring ultrason absorption is used for various organic liquids at roo temperature and at frequencies of 3 to 15 Mc/ The effect of molecular symmetry on absorption studied for the pairs benzene, toluene; paraxylen orthoxylene; and cyclohexane, methyl cyclohexan The effect of double *v.* single bond is given fo tetrachlorethane *v.* tetrachloroethylene. The effect c viscosity on absorption is shown to be almost neg ligible for solutions of polystyrene in either toluen or benzene. Finally, a possible explanation alon relaxational lines is suggested. A

534.21

2981. Transmission of 24-kc underwater soun from a deep source. M. J. SHEEHY. *J. Acoust. Soc Amer.*, **22**, 24–8 (*Jan.*, 1950).

Experiments are reported in which 30 msec signal of 24 kc/s sound were emitted in the ocean ever second at depths of 150, 300, 500 and 1 000 ft, by relatively non-directional projector, and were receive by similar units at the same depths after havin travelled 100 to 3 000 yd. A recording techniqu was used which made it possible to resolve the direc and surface-reflected components. Transmissio conditions near the surface were poor during the experiments, and the transmission was found t improve as the projector and receiver depths increased The average attenuation at the greatest depths wa about 6 db/1 000 yd in addition to the loss caused by an assumed inverse-square divergence of the sound energy. Although the emitted signals had rectangular envelopes and were all of the same amplitude, the amplitudes of the received signals fluctuated from signal to signal and within each signal. The fluctua tion of the directly transmitted signals showed a general tendency to increase with range in proportion to the square root of the range. The magnitude of this fluctuation changed from about 10% of the average amplitude at 100 yd to 45% at 3 000 yd. The fluctuation of the surface-reflected component was > that of the direct component and did not depend on range. A

534.213

2982. Acoustical properties of anisotropic materials. W. J. PRICE AND H. B. HUNTINGTON. *J. Acoust. Soc. Amer.*, **22**, 32–7 (*Jan.*, 1950).

Several acoustic properties of anisotropic media have been investigated by the pulsed ultrasonic method and the results analysed in terms of plane waves travelling through an infinite medium. Single crystals of ammonium dihydrogen phosphate (ADP) and potassium dihydrogen phosphate (KDP) were

e subjects of this study and in each case velocity easurements were used to compute a complete set elastic moduli. Coupling between modes which sults in the simultaneous generation of two modes a transducer and in the transfer of energy between odes during a reflection was studied. The phenoenon of acoustical birefringence in ADP was rticularly investigated and it was found that all the 3 modes with wave normals in the 45° direction the yz plane are propagated in different directions aking non-zero angles with the wave normals. case in which the anisotropic property of the edium causes anomalous beam spreading is ported and the circumstances leading to this ndition are discussed. A.

534.213.4

983. Theory of the sound oscillations in open bes. L. A. VAĬNSHTEĬN (WEINSTEIN). *J. Tech. hys., USSR*, **19**, 911–30 (*Aug.*, 1949) *In Russian.*

The strict solution of the problem of the radiation om the open end of a pipe is given for the case of a mmetrical sound wave propagated in the tube in he direction of the open end. The transformation oefficients of this wave into waves of other indices re also calculated, as well as the reflection coefficients f various waves at the open end. Graphs of the bsolute values and phases of these coefficients are iven and also "open-end corrections" of the fundaental ("piston") wave. The characteristics of the adiation emitted from the open end are investigated nd the theory is generalized to include asymmetrical aves. The excitation of waves in open pipes is onsidered and it is shown how to calculate the esonance curve of a cylindrical resonator of finite ngth, open at one end. The theoretical results are hecked on experimental data. B. F. KRAUS

534.213.4

984. Attenuation in a rectangular slotted tube of 1,0) transverse acoustic waves. H. E. HARTIG AND . F. LAMBERT. *J. Acoust. Soc. Amer.*, **22**, 42–6 *Jan.*, 1950).

A pick-up device for measuring the standing wave atio of transverse acoustic waves is described. One f the important features of this device is the elimiation of interference from the residual plane wave. n experimental study of the attenuation characeristics of (1,0) transverse acoustic waves propagated n air in a rectangular metal tube employing such a ick-up device is presented in this paper. This study eveals that three losses are important contributors o the attenuation. The results are in good agreement vith a tube wall effect predicted by Kirchhoff. In vidence is a gaseous absorption in the medium due o thermal equilibrium adjustments. The remaining ttenuation is appreciable and appears to vary with requency as $f^2[1 - f_c^2/f^2]^{-\frac{1}{2}}$. This factor is here ttributed to a vibration of the tube walls. A.

534.213.4

985. On the change of cross section and bifurcation f a cylindrical tube. J. W. MILES. *J. Acoust. Soc. Amer.*, **22**, 59–60 (*Jan.*, 1950).

The equivalence between the problems of the hange of cross-section and the bifurcation of a ylindrical tube, previously stated as exact [Abstr. 3445 (1947)] is only approximate. An exact solution to the latter problem (for a circular tube) has been given, and the results are compared with recent calculations for the change of cross-section. The approximate equivalence between the 2 results is found to be sufficiently close for many applications but to be far from exact. A.

534.222

2986. A new phenomenon in hydroacoustics. L. D. ROSENBERG. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 2) 175–6 (1949) *In Russian.*

In the course of experiments carried out in 1946 it was established that the distance from the source at which a sound impulse under deep water could be recorded was at least several 100 km. The limiting distance could not be established under the experimental conditions, but at a distance of 560 km the signal level was high enough to indicate that the furthest distance would be considerably greater than this. The form of the signal varied with the distance as well as the intensity. For short distances the signal begins with a high peak after which it falls to zero, thereafter the level increases almost to the level of the first impulse after which there is a comparatively slow fall in the sonic pressure. At large distances, however, the signal has the form of a steadily increasing process reaching its max. towards the end after which it falls sharply to zero. The power of the source cannot account for the phenomenon. W. HUGHES

534.222

2987. The distribution of sound in an underwater sound canal. L. M. BREKHOVSKIKH. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 2) 157–60 (1949) *In Russian.*

It has been shown [Abstr. 2988 (1950)] that the phenomenon of "super distant" distribution of sound in deep water can be explained by the existence of an underwater sound channel. The assumption was made that there is a linear relation between velocity and depth: this is not true in practice, and a closer approximation is now made. The results deduced are in good agreement with experiment [see preceding Abstr.]. The work of foreign workers is criticized on the grounds that such factors as change of signal form with distance and the relation between max. signal strength and distance from source are not considered. [See Abstr. 3657 (1948)].

W. HUGHES

534.222

2988. Distribution of sound in a layer of liquid with a constant gradient of propagation rate. L. M. BREKHOVSKIKH. *Dokl. Akad. Nauk, SSSR*, **62** (*No.* 4) 469–71 (1948) *In Russian.*

534.222.2

2989. The diffraction of blast. II. M. J. LIGHTHILL. *Proc. Roy. Soc. A*, **200**, 554–65 (*Feb.* 22, 1950).

The head-on encounter of a plane shock, of any strength, with a solid corner of angle $\pi - \delta$ is investigated mathematically, when δ is small, by a method similar to that of part I [Abstr. 6822 (1949)]. A.

534.222.2 : 537.528

2990. Investigations on spark sound waves by means of X-ray flashes. W. SCHAAFFS. *Z. Naturforsch.*, **4a**, 463–72 (*Sept.*, 1949) *In German.*

X-ray screen flashes of an electric spark discharge

in a fluid dielectric reveal a central space of gas discharge which is surrounded by a concentric space of high compression. The compression causes an increased absorption of X-rays, thus permitting high-speed radiographs of the phenomenon to be taken. Details of the technique are described and the dependence of the phenomenon on the discharge between electrodes and on the thickness of the layer of the liquid are studied from flash radiographs using C_6H_5Br and C_2HCl_3 as liquids. The velocities of the spark sound waves and the resulting dynamic pressures have been determined. The construction of the X-ray flash tube is described. [Abstr. 1782 (1950)]. R. H. HERZ

534.231

2991. The sound field in the vicinity of a free vibrating piston diaphragm. J. MEIXNER AND U. FRITZE. *Z. angew. Phys.*, **1**, 535–42 (*Dec.*, 1949) *In German.*

The sound distribution has been calculated for various ratios of piston diameter to wavelength, and compared with the sound field due to the same piston source operating in an infinite rigid wall (according to Stenzel). Sound fields of this nature are plotted for the cases $ka = 4$, 6 and 10. Reference is made to theoretical work of Rayleigh, Stenzel and McLachlan. A. B. WOOD

534.231

2992. Supersonic vibration potentials (Debye effect) in colloidal solutions. A. J. RUTGERS AND J. VIDTS. Letter in *Nature, Lond.*, **165**, 109 (*Jan.* 21, 1950).

A colloidal solution of As trisulphide was used with a 100 W oscillator and high gain amplifier in an attempt to measure the velocity amplitude of an ultrasonic wave in the liquid by measuring the acoustic pressure with a hollow prism hydrostatic balance. The method was not satisfactory. The Debye effect was large, the potentials varying from 12 to 45 V which corresponded with an amplitude for the ultrasonic vibration of 1·47 mV. A theoretical estimate gave a value of 7 mV and it was considered that the discrepancy between the two values was $\ll$ had been reported previously. A. C. WHIFFIN

534.231

2993. The Debye effect in electrolytes. A. N. HUNTER. Letter in *Proc. Phys. Soc., Lond. B*, **63**, 58–9 (*Jan.*, 1950).

P. Debye [*J. Chem. Phys.*, **1**, 13 (1933)] has predicted the existence of an alternating electric potential at a point in an electrolyte through which a sound wave is passing. Using Debye's formula, the author has calculated that this potential in a dilute solution is of the order 1 mV when the particle velocity amp. is 1 cm/s at a sound intensity of 1/100 W/cm². Observations by various experimenters have, however, indicated that the actual potential is $\ll$ the expected value, and for reasonable sound intensities is not much above noise level. The reasons for this are discussed. The author is developing a sound pulse method the duration of the pulse being such that, with the length of the sound path used, the source is inoperative during detection of the effect. He proposes to use a frequency of 465 kc/s, pulse duration of 1 msec and probes spaced $\lambda/2$ apart. A. B. WOOD

534.231

2994. The acoustical impedance of a bubbly mixtu and its size distribution function. N. DAVIDS AN E. G. THURSTON. *J. Acoust. Soc. Amer.*, **22**, 20 (*Jan.*, 1950).

A statistical method is described which enables analytical bubble size distribution to be formulat from the rough size grouping usually obtained wi practical methods of experimental graphs of bubb turbulent water. The resulting function is used wi certain known formulae for evaluating the acoustic impedance of such a mixture. A brief physic interpretation of the effects predicted by the theo is given.

534.231

2995. Ultrasonic interferometry for low acoust impedance. J. L. STEWART AND E. S. STEWAR Letter in *Phys. Rev.*, **77**, 143–4 (*Jan.* 1, 1950).

The theory of the ultrasonic interferometer is em ployed to compute the amplitude absorption coefficie per cm and the exponential form of the amplitu reflection coefficient. Measurements are made of th current in the parallel resonance circuit correspondin with the acoustic pressure at the source when operatin into a vacuum and into a fluid without reflectio The deduction of the coefficients from these data simplified in the region of low acoustic impedanc and the technique is particularly applicable to th investigations in gases at low pressure. A. C. WHIFFI

534.22

2996. A resonance method for measuring th sensitivity and damping of ultrasonic receivers for us in water. R. BIERL. *Z. angew. Phys.*, **1**, 557–6 (*Dec.*, 1949) *In German.*

A description of apparatus for obtaining th resonance curve of a receiver by analysing its respons to a continuous ultrasonic spectrum ranging fro 15–35 Mc/s. H. J. H. STARK

534.23

2997. A crystal pick-up for measuring ultrasoni wave velocity and dispersion in solid rods. A. I BAKANOWSKI AND R. B. LINDSAY. *J. Acoust. Soc Amer.*, **22**, 14–16 (*Jan.*, 1950).

A piezoelectric crystal pick-up has been designe constructed and successfully applied to the detectio of internodal distances in a solid metal rod vibratin at resonance and thus to the evaluation of configura tional dispersion of ultrasonic compressional radiatio in the rod. The use of the pick-up yields results a accurate as the powder method and can be applie in certain cases where the latter fails. A

534.23

2998. Reciprocity pressure response formula whic includes the effect of the chamber load on the motio of the transducer diaphragms. M. S. HAWLEY *J. Acoust. Soc. Amer.*, **22**, 56–8 (*Jan.*, 1950).

534.2

2999. Spherical aberration of sound lenses. B. D TARTAKOVSKIĬ. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 1 29–32 (1949) *In Russian.*

The relation of longitudinal aberrations to speed of sound propagation is expressed algebraically, an it is shown that the aberration is reduced to zero i conformity with the refractive index. Refractive

dex values corresponding to longitudinal spherical berrations for various types of lens (optimum curve, oncave and convex) are tabulated. Graphs indicate:) relations between lens aperture and aberration, here the exact magnitude of the latter cannot be therwise determined; (2) dependence of lens aperture n refractive index for a given aberration magnitude.

J. CLEUGH

534.25

000. Acoustic double refraction of pure liquids. . PETERLIN. *J. Phys. Radium*, **11**, 45–8 (*Jan.*, 1950) *n French.*

Lucas [*C.R. Acad. Sci.*, **206**, 827 (1938)] has found hat very viscous liquids such as castor oil and linseed il, show double refraction (to light) when under the nfluence of very intense ultra sound. In the author's heoretical explanation of this phenomenon he egards the molecules of liquid as rigid ellipsoids of evolution, which tend to orient themselves under the nfluence of the ultrasonic field in such a way that he major axis coincides with the axis of maximum ilation. The orientation is defined according to the quilibrium between this regular movement of the nolecules and the Brownian motion. The double efraction which results is $\propto$ the square root of the ntensity of the sound field and to the frequency until the phenomena of relaxation become appre-iable. The frequency of relaxation $\omega = 2\pi\nu$ is equal o $6D$ where D is the constant of rotational diffusion. For extreme frequencies the double refraction attains a limiting value. The theory explains experimental observations fairly satisfactorily. A. B. WOOD

534.26

3001. Scattering of ultrasonic waves in gases. M. MOKHTAR AND M. SHEHATA. *J. Acoust. Soc. Amer.*, **22**, 16–19 (*Jan.*, 1950).

Ultrasonic beams of frequencies in the range of 80 kc/s to 1 000 kc/s emerge from a rectangular slit of known adjustable width into air, O, or CO_2. The disposition of the field in front of the slit is studied by the aid of a hot wire anemometer, which gives the angle of divergence of the beam and the intensity distribution across the main and the diffracted beams. The results obtained indicate that the laws of diffraction are valid so long as the gas is far removed from its anomalous dispersion region. CO_2 in the range between 100 and 200 kc/s shows a high degree of scattering with the result that the emergent beam loses its definition completely and becomes very diffused. A.

534.26

3002. Erratum: The diffraction of sound by rigid disks and rigid square plates. F. M. WIENER. *J. Acoust. Soc. Amer.*, **22**, 47 (*Jan.*, 1950).

Abstr. 6042 (1949). Two integrals are corrected.

534.26

3003. Variational principles in acoustic diffraction theory. H. LEVINE. *J. Acoust. Soc. Amer.*, **22**, 48–55 (*Jan.*, 1950).

The diffraction of a plane harmonic sound wave by an aperture in an infinitely thin rigid plane screen is investigated theoretically. A.

534.321.9

3004. Generation and analysis of ultrasonic noise. S. C. GHOSE. *Nature, Lond.*, **165**, 66–7 (*Jan.* 14, 1950).

To study physiological effects of ultrasonic noise produced by aircraft, apparatus has been devised to analyse and generate such noise in the laboratory to determine its effect on living organisms. A condenser microphone was devised having a fairly even response up to 100 kc/s and a circular polar diagram in the plane of the diaphragm. A piezoelectric microphone was also produced, and both were calibrated against a hydrophone. Hartmann generators were devised to cover the required frequency range, 35 such generators being employed at intervals of 3 kc/s. An ultrasonic siren was devised in which compressed air was blown through slots opened and closed by a toothed disc. A. C. WHIFFIN

534.413

3005. Mechanism of "sensitive jets." M. DUBOIS. *C.R. Acad. Sci., Paris*, **229**, 747–9 (*Oct.* 17, 1949) *In French.*

The sensitive jet, observed stroboscopically, is considered in the 3 stages: (1) a transverse undulation of the jet as it emerges from the orifice; (2) the progression of these undulations, with amplification, along the jet; and (3) the arrival at and state of instability in the jet which becomes turbulent and opens into "plumes" (panache). It is suggested that the phenomena are comparable to those observed when the cylindrical tube, from which the jet emerges, is oscillating transversely, instead of the tube being fixed and the jet set in oscillation by the ambient sound-field (directed across the jet). The problem is regarded as one of composition of velocities at the orifice. The effect of entrainment of air, by viscosity, in the jet is considered. A. B. WOOD

534.414

3006. Acoustic resonators of circular cross-section and with axial symmetry. A. K. NIELSEN. *Trans. Danish Acad. Tech. Sci.* (*No.* 10) 9–70 (1949).

Formulae are given which enable the frequency of such resonators to be calculated with great accuracy, when losses due to viscosity and heat exchange are neglected. An approximate boundary-layer theory is developed to account for the effect of these losses, and the calculations are compared with precise measurements. The agreement between calculated and measured resonance frequencies is better than 1%. It is shown that the usual approach to resonator theory is inadequate for two reasons: (1) the velocity distribution in the coupling aperture is usually assumed constant, but it is shown that this assumption violates the boundary condition at the sharp edge of the coupling aperture where the velocity becomes infinite; (2) because of the interaction between the wave emitted from the coupling aperture and the wave reflected from the cylindrical walls of the resonator. Van den Dungen's results for a flanged organ pipe deviate from Rayleigh's calculation. It is now shown that the discrepancy is due to his failure to realize certain implicit assumptions in his method of approximation. The effect of flanges of various diameters on an open organ pipe was also investigated. A. B. WOOD

534.414 : 532.68

3007. Mechanical resonance in freely falling raindrops. R. GUNN. *J. Geophys. Res.*, **54**, 383–5 (*Dec.*, 1949).

Non-spinning water-droplets weighing $\gg$ or $\ll$ $\frac{1}{2}$ mg fall vertically. Droplets near this mass, however, exhibit a transverse drift of sufficient magnitude to interfere with experiments. This behaviour has been investigated and is believed to be due to resonance. Freely falling water-droplets possess a natural frequency of oscillation dependent on their size and surface tension. An exploration of possible driving mechanisms showed that the aeolian frequencies produced by the periodic detachment of eddies had the right frequency to excite the self-oscillation of the falling droplets. On a curve connecting the natural frequency of oscillation with the mass, another curve connecting the mass with the eddy detachment frequency is plotted, using wind-tunnel data. These curves intersect at a large angle near $\frac{1}{2}$ mg, suggesting that the peculiar lateral drift is due to mechanical deformation and resonance in the freely falling droplets. A.

534.612

3008. A method of measuring the pressure due to ultrasonic waves. H. GOETZ. *Z. Naturforsch.*, **4a**, 587–8 (*Nov.*, 1949) *In German.*

A stream of air bubbles rising in paraffin oil from a jet near the base is deflected from its vertical path by the pressure generated by an ultrasonic transmitter. The intensity of the sound I is given by the equation $I = pu$ where u is the velocity of sound in the oil and p is determined from the deflection of the stream of air bubbles by the formula $p = (8rng v)^{\frac{1}{2}}/\tan\theta$. In this formula, r is the difference in the densities of the paraffin and the air, n is the viscosity of the paraffin, v is the velocity of the air bubbles, and θ is the angular deflection of the air stream. In tests with a quartz transmitter operating at 4·2 Mc/s when connected with a circuit producing 11½W, the intensity in the paraffin was 1·5 W/cm² and the air stream was deflected by 33°. A. C. WHIFFIN

534.614

3009. An optical method of measuring the velocity of supersonic waves. V. TSVETKOV AND V. MARININ. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 1) 49–53 (1949) *In Russian.*

The method is based on the direct observation of an ultrasonic lattice formed by plane waves during stroboscopic illumination by a light shutter synchronized with the wave generator. A quartz crystal transmits plane ultrasonic waves through the liquid under examination in the x direction. The refractive index n of the liquid in the sonic field can be represented by

$$n = n_0 + \Delta n = n_0 + \Delta n_0 \sin 2\pi[t/T - x/\lambda]$$

where T is the vibration period, λ the wavelength and n_0 the refractive index in the absence of the ultrasonic waves. The optical system is shown. A Kerr cell (opening once only in the period T) is used as a light shutter. Results are given for a series of saturated fatty acids and alcohols and the molar velocity calculated. The change in molar velocity with successive addition of CH_2 groups $\simeq$ 190 m in agreement with other authors [e.g. Lagemann Abstr. 1792 (1948)]. W. HUGH

534.

3010. A method of calculating hearing loss f speech from an audiogram. H. FLETCHER. *J. Acous Soc. Amer.*, **22**, 1–5 (*Jan.*, 1950).

534.

3011. The masking of pure tones and of speech b white noise. J. E. HAWKINS, JR. AND S. S. STEVEN *J. Acoust. Soc. Amer.*, **22**, 6–13 (*Jan.*, 1950).

Presents the results of a study of the monaura masking of pure tones by white noise at 8 sensatio levels (*SL*) from 20 to 90 db. The observed values masking were employed to determine 2 basic fun tions: (*a*) the critical bandwidth of a masking nois i.e. the ratio, in decibels, between the level of a pu tone and the level per cycle of the noise that is ju able to mask the tone; (*b*) the function relating th amount of masking to the effective level of th masking noise.

534.83

3012. Panel absorbents of the Helmholtz typ P. V. BRÜEL. "*Resonant absorbers and radiation*" (*Phys. Soc., Lond.*, 1949) 10–17.

Actual absorbents of sound are described and the efficiency discussed, chiefly in commercial use. The most favourable wavelength is calculated when possible, and the range of frequency is represented o a diagram. G. GREE

534.83

3013. Sound absorption at low frequencies b resonant absorbers. A. J. KING. "*Resonant absorber and radiation*" (*Phys. Soc., Lond.*, 1949) 17–23.

The theory used is that of Helmholtz and Rayleig regarding resonators. Acoustic impedance is measure of an actual resonator and of the same provided wit a cover sheet. Dimensions are given and a table i provided showing the effect of the cover sheet. useful discussion follows. G. GREE

534.83

3014. Acoustic filter for water-filled pipes. R. M HOOVER, D. T. LAIRD AND L. N. MILLER. *J. Acoust Soc. Amer.*, **22**, 38–41 (*Jan.*, 1950).

Discusses problem of noise suppression for a larg water-tunnel.

534.83

3015. The performance of a portable objective nois meter in which sound levels are corrected by peak/r.m.s measurements. A. J. KING. "*Noise and sound trans mission*" (*Phys. Soc., Lond.*, 1949) 125–7.

Developments of the instrument previously des cribed [see Abstr. 1631 (1941)] are outlined and it performance compared with that of a subjective nois meter, satisfactory agreement being obtained.

G. F. HODSMA

534.83

3016. The objective measurement of noise, it possibilities and limitations. P. BARON. "*Noise an sound transmission*" (*Phys. Soc., Lond.*, 1949) 129–32

The desirability of limiting the interpretation o

measurements to the comparison of similar noises is stressed, uncertainties due to meter calibrations and physiological causes being discussed. Mention is made of the general principles governing the annoyance due to noises and of the desirable specifications for noise reduction. G. F. HODSMAN

534.84

3017. Theory of linings for anechoic rooms, based on the principle of gradual transition. A. SCHOCH. "*Noise and sound transmission*" (*Phys. Soc., Lond.*, 1949) 167–73.

Following a consideration of the reflection of sound waves from uniform plates of porous material, an indication is given of the theoretical approach to the design of pyramid- or wedge-shaped elements of porous material projecting from the boundary surface for minimizing sound reflection. Curves are given for a linear wedge structure showing how the reflection factor depends on the frequency parameter, flow resistance parameter, and on the position in the structure. G. F. HODSMAN

534.843

3018. Fundamental theorems of indoor acoustics. E. SKUDRZYK. *Acta Phys. Austriaca*, **3** (*Nos* 2–3) 229–69 (1949) *In German.*

The various sound waves from an original source reaching an observer placed at any point within an enclosure are first considered. The optimum conditions for good and bad reception are then determined—depending upon shape, size, nature of walls of enclosure. The investigation involves the power of the human ear to co-ordinate sound impulses from the same source at $< \frac{1}{20}$ sec apart, but does not consider impulses from continuous sources. Special cases are considered, and a short mathematical treatment is appended. G. GREEN

534.844

3019. Reverberation time as an index of room performance. J. MOIR. "*Resonant absorbers and radiation*" (*Phys. Soc., Lond.*, 1949) 24–31.

Experiments are quoted to show that reverberation time is not a satisfactory index of room performances. The failure seemed to be due to the initial conditions of the room. Use is now made of a formula of Rayleigh's connecting time of decay with wavelength, and results obtained for small and large rooms are recorded in a table. Sabine's law is now seen to be a first-order approximation. G. GREEN

534.844

3020. The interpretation of pulse measurements as an index of room performance. C. A. MASON. "*Resonant absorbers and radiation*" (*Phys. Soc., Lond.*, 1949) 31–4.

Cinemas with the same reverberation time show great differences in reproducer quality. Pulse photographs 50 milliseconds long show considerable confusion, but photographs 20 milliseconds long give useful information as to echo paths and as to the general assessment of sound quality. Experimental figures are also reproduced. G. GREEN

535.231.4

3021. Emissivities of copper and aluminium. G. BEST. *J. Opt. Soc. Amer.*, **39**, 1009–11 (*Dec.*, 1949).

The total hemispherical emissivities were determined over the approximate range of temps. from 100°c to 400°c. That of Cu was found to be practically constant at 0·03, but for Al the value was considerably higher and showed a temp. dependence. A.

535.234 : 518.5

3022. A slide rule for radiation calculations. M. W. MAKOWSKI. *Rev. Sci. Instrum.*, **20**, 876–84 (*Dec.*, 1949).

535.243 : 531.715.27

3023. Double-trace scanning microphotometer for precision measurement of line position. T. B. RYMER AND J. S. HALLIDAY. Letter in *J. Sci. Instrum.*, **27**, 50–1 (*Feb.*, 1950).

A technique using a double-beam c.r.t. whereby settings can be made with an accuracy of about 1 or 2 μ is briefly described. R. F. BARROW

535.317

3024. The general theory of isoplanatism for arbitrary openings and fields. II. Extra-meridian bundles. M. DI JORIO. *Nuovo Cim.*, **6**, 435–55 (*Nov.*, 1949) *In Italian.*

The theory previously developed for meridian rays [see Abstr. 521 (1949)] is extended to extra-meridian bundles. The isoplanatic condition is expressed in terms of two fundamental aberrations: the total axial aperture aberration, present also for meridian rays, and the total oblique aperture aberration, characteristic of the extra-meridian case. Several examples are treated. An expression is also given for the elementary deformation when the isoplanatic condition is not satisfied; this deformation may be taken as the basis of a general theory of the image given by optical systems with a plane of symmetry. The theory of coma is deduced as an application. L. PINCHERLE

535.317.3

3025. Color correction in optical systems and types of glass. M. HERZBERGER AND H. JENKINS. *J. Opt. Soc. Amer.*, **39**, 984–9 (*Dec.*, 1949).

The authors suggest that the optical qualities of a transparent material are given with the help of 3 graphs, one a plot of the reciprocal dispersion $1/(n_F - n_C)$ against the ν-value, the other 2 giving 2 data ρ_A and ρ_h signifying the deviation of the dispersion of the glass toward the red and violet ends of the spectrum from the regular standard. A universal dispersion formula is given which permits one (*a*) to calculate the refractive index for any given wavelength if the above data are given; and (*b*) to compute the above data if the refractive index is given for 4 or more values. The dispersion formula is linear with respect to the given data. The graphs so designed permit one to estimate immediately the powers of a doublet corrected for 2 wavelengths and the amount of the secondary spectrum in the red and violet ends for any two given glasses. A.

535.32 : 537.29

3026. On the influence of electric fields on the spreading of light rays. J. SPERLING. *Optik*, **5**, 189–96 (*June*, 1949) *In German.*

An arrangement is described which tests Stark's claim [*Phys. Bl.*, **5**, 162 (1947)] that light passing a highly charged knife-edge is bent. The electric field was inhomogenous, and applied to the edge and a brass plate opposite: the max. field was 1 270 kV/cm. The Schlieren method used gave a sensitivity 10 times > Stark's, but his result was not confirmed. The same applied to light passing through a slit consisting of two knife-edges: in this case there occurred a spurious effect due to sparking between the edges. The polarizing effect of edges on light and the variation with wavelength, slit-width and slit-depth are also discussed. Diagrams and photographs are given.

R. A. WEALE

535.324 : 536.423

3027. Physical properties of sixty API–NBS hydrocarbons. A. F. FORZIATI AND F. D. ROSSINI. *J. Res. Nat. Bur. Stand., Wash.*, **43**, 473–6 (*Nov.*, 1949).

The results of experimental determinations of the density at 20°, 25° and 30°C, the refractive index, n_D, at 20°, 25° and 30°C, and the boiling point and pressure coeff. of the boiling point, at 1 atm., are reported for 60 hydrocarbons, including 17 paraffins, 14 alkylcyclopentanes, 8 alkylcyclohexanes and 21 alkylbenzenes. A.

535.324 : 537.226.2

3028. Refractive indices and dielectric constants of liquids and gases under pressure. J. S. ROSEN. *J. Chem. Phys.*, **17**, 1192–7 (*Dec.*, 1949).

Several interpolation formulae are given which reproduce refractive index and dielectric constant data for liquids and gases at high pressures. These formulae involve functions of the refractive indices and dielectric constants which appear in the formulae of Lorentz–Lorenz, Clausius–Mosotti, Gladstone and Dale, the empirical Eykman formula, etc. One formula shows the reciprocals of these functions to be linear in the specific volumes at various pressures. Another interpolation formula, involving the reciprocals of the same functions, contains a logarithmic term which is similar to that appearing in the Tait equation for compressibilities of liquids. The parameters involved in the Tait equations for compressibilities and in the analogous interpolation formula for refractive indices and dielectric constants are discussed. The article also shows that the Tait equation which has been so successfully adapted to compressibility data of liquids can also be applied to gases. A.

535.33.03

3029. The possibility of enhanced Hg^{202} as a source of monochromatic light. J. R. MCNALLY, JR., P. M. GRIFFIN AND L. E. BURKHART. *J. Opt. Soc. Amer.*, **39**, 1036–7 (*Dec.*, 1949).

Electromagnetically enhanced Hg^{202}, as a source material for highly monochromatic radiation, is discussed briefly with relation to the effects of the isotopic impurities. A Fabry–Perot interferogram showing line purity in the 98·06% Hg^{202} is reproduced. A.

535.33.03 : 537.523

3030. On the alteration with time of the spectra character of electric sparks. J. VAN CALKER AN E. TACKE. *Z. Naturforsch.*, **4a**, 573–5 (*Nov.*, 1949) *German.*

Sparks between metals, or of Li or Ba salts on C were spectrographed with stroboscopic arrangemen for selecting intervals during the passage of singl sparks. Each line shows a characteristic intensit change with time. Arc and spark lines are similar i reaching their maxima more quickly, the higher the excitation energy. S. T. HENDERSO

535.33

3031. Note on a correction by Laporte to Ostrofsky formulae [for term values in d^4 Nb]. V. RAMAKRISHN RAO. Letter in *Curr. Sci.*, **18**, 435–6 (*Dec.*, 1949).

See Abstr. 1856 (1942); 2415 (1949).

535.33

3032. Nomograph of Hg 5461 structure as a functio of etalon separation. J. R. MCNALLY, JR. Letter i *J. Opt. Soc. Amer.*, **39**, 1050 (*Dec.*, 1949).

535.33

3033. A study of the spectra of columbium an molybdenum in the extreme ultraviolet. G. W CHARLES. *Phys. Rev.*, **77**, 120–4 (*Jan.* 1, 1950).

535.33

3034. New terms of the $5d^86s^2$ and $5d^86s6p$ con figurations of the spectrum of Hg III. E. W. FOSTE *Proc. Roy. Soc. A*, **200**, 429–37 (*Feb.* 7, 1950).

The $J = 0$ terms of the $5d^86s^2$ configurations hav been located and 2 others have been revised, so tha all 9 terms are now established. 11 new terms c $5d^86s6p$ are reported. The new terms and severa previously reported by Johns are supported b observations of isotope shifts. A

535.33

3035. The spectrum of atomic oxygen in a high current a-c. discharge. W. PETRIE, P. A. MONAGHAN AND P. A. DOLAN. *Canad. J. Res. A*, **27**, 213–1 (*Nov.*, 1949).

535.33

3036. Spectrum of monobromobenzene. K SREERAMAMURTY. Letter in *Curr. Sci.*, **18**, 437 (*Dec.* 1949).

535.33

3037. The infra-red spectrum and molecular con figuration of hydrogen persulfide. M. K. WILSON AN R. M. BADGER. *J. Chem. Phys.*, **17**, 1232–6 (*Dec.*, 1949).

535.33

3038. The vibrational spectra of molecules and complex ions in crystals. II. Benzene. R. D. MAIR AND D. F. HORNIG. *J. Chem. Phys.*, **17**, 1236–47 (*Dec.*, 1949).

The infrared spectrum of crystalline benzene has been studied at −12°C, −65°C and −170°C as well as the liquid at 28°C. The lines are extremely sharp, the mean line width for fundamentals being 7 cm^{-1} in the crystal. In 3 cases, it is < the spectral slit width. All out-of-plane degenerate modes are split by about 10 cm^{-1}. Selection rules are obeyed and agree with the reported X-ray structure. All ungerade fundamentals are observed directly, some for the first time. 52 combination bands are observed. The

requency assignments of Ingold *et al.* are confirmed xcept for the B_{2u} species. Evidence is cited for e-assigning ν_{14} from 1 648 cm^{-1} to 1 310 cm^{-1} and ν_{15} from 1 110 cm^{-1} to 1 150 cm^{-1}. Ingold's isotopic ata does not conflict with this change. Combination requencies involving torsional lattice modes are pparently observed at −170°C. A.

535.333

3039. On the emission bands of CCl. P. VENKATESVARLU. *Phys. Rev.*, **76**, 79–80 (*Jan.* 1, 1950).

Some new bands of CCl are recorded and these, ogether with those reported by earlier workers, are rranged in a vibrational scheme. The electronic ransition is $^2\Sigma \rightarrow {}^2\Pi$, the doublet separation for the Π state being 138 cm^{-1}. By way of comparison it s mentioned that the uncondensed transformer lischarge gave CF_2 bands in the case of CF_4, CCl nd Cl_2 bands in the case of CCl_4 and only Br_2 bands n CBr_4. It is pointed out that the supposed CBr ands reported by Durie and Iredale are not due to CBr but due to Br_2. A.

535.337

3040. On "forbidden" components in the Zeeman effect. V. S. MILIYANCHUK. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 1) 41–4 (1949) *In Russian.*

The weak "forbidden" Zeeman components in a trong magnetic field under high pressure are result of interaction of atoms. For a cylindrically symmetric strong field the dipoles of the forbidden ransitions are calculated; for $^2S_{1/2}$, $^2P_{3/2}$ lines intensities are as follows: forbidden σ component $+\frac{9}{3}$ weaker han $-\frac{9}{3}$, forbidden σ component $+\frac{1}{3}$ stronger han $-\frac{1}{3}$. Agreement with experiment suggests that he intermolecular field affects the appearance of forbidden lines and the intensity of allowed ones. Nuclear spin alone could not explain asymmetry of intensities. J. JACOBS

535.338.332

3041. On the hyperfine structure of the $^2P_{\frac{1}{2}}$ state of Tl^{205} and Tl^{203}. A. BERMAN, P. KUSCH AND A. K. MANN. Letter in *Phys. Rev.*, **77**, 140–1 (*Jan.* 1, 1950).

535.338.4

3042. Flame spectra and kinetics of radical reactions. H. BEHRENS. *Naturwissenschaften*, **36** (*No.* 12) 374 (1949).

The absence of C_2 bands from flames supported by NO is attributed to removal of C_2 by reaction with NO to form CO and CN. Reactions of C_2 and CH with NO are discussed; also reactions of S_2 in flames. A. G. GAYDON

535.338.4

3043. Flame spectra. A. G. GAYDON. *Nature, Lond.*, **165**, 170–3 (*Feb.* 4, 1950).

Royal Institution discourse.

535.339

3044. Multi-slit double monochromator using no moving parts. W. A. SHURCLIFF. Letter in *J. Opt. Soc. Amer.*, **39**, 1048 (*Dec.*, 1949).

535.343

3045. The presentation of absorption spectra data. W. R. BRODE. *J. Opt. Soc. Amer.*, **39**, 1022–31 (*Dec.*, 1949).

A survey has been made of the systems used for the presentation of absorption spectra data in textbooks and journals. An attempt has been made to determine the accepted nomenclature systems, and recommendations have been made where there is some uncertainty as to proper or desirable form of presentation. Examples of data and graphical relation of values have been given to show the relative form of data as presented by different systems. A.

535.343

3046. A quantum-mechanical theory of light absorption of organic dyes and similar compounds. H. KUHN. *J. Chem. Phys.*, **17**, 1198–211 (*Dec.*, 1949).

535.343

3047. The ultraviolet absorption spectra of aliphatic nitramines, nitrosamines, and nitrates. R. N. JONES AND G. D. THORN. *Canad. J. Res. B*, **27**, 828–60 (*Nov.*, 1949).

535.343.2

3048. Optical absorption in barium oxide films. W. W. TYLER. Letter in *Phys. Rev.*, **76**, 1887–8 (*Dec.* 15, 1949).

The thickness of the films varied from 0·2 to 0·4 μ, they were obtained by evaporation from a coated Pt filament on to a quartz plate. The wavelengths for which absorption was measured ranged from 2 000–4 000 Å; measurements were taken at room temperature and at -150 ± 10°C. At the higher temperature the transmission, uncorrected for interference and reflection effects, is lower. The films are apparently deposited in the shape of small crystals of the same form as larger crystals studied. The optical absorption threshold coincides with that for photo-conductivity at 3·8 eV. The magnitude of the absorption constant A is so large that the absorption process cannot be due to impurity centres in the lattice. A does not vary appreciably with a 20-fold increase in light intensity. Graphs are given.

R. A. WEALE

535.343.2 : 548.7

3049. Infra-red color centre bands in the alkali halides. E. BURSTEIN AND J. J. OBERLY. Letter in *Phys. Rev.*, **76**, 1254 (*Oct.* 15, 1949).

I.r. absorption bands are produced in alkali halides by X-ray irradiation followed by irradiation with white light. Bleaching of F and M bands is shown to be more difficult as X-ray dosage is increased. With high dosage R bands appear together with new bands in the near i.r. (N bands). The residual colour is found to be confined to a thin surface layer of the crystal. The i.r. bands show fine structure at low temps. and they are also found in additively coloured crystals of KCl, KBr and NaCl. The N bands are either due to trapped electrons at specific clusters of ion vacancies or to 2-dimensional aggregates of F-centres. Inability to bleach bands indicates diffusion of positive holes from the surface layers of the crystal and loss of halogen from the crystal is possible. It is likely that X-ray irradiation increases negative ion vacancies which provides conditions favourable to aggregation of F-centres. Measurements are being made on changes in ionic conductivity and dielectric loss during X-ray irradiation. G. F. J. GARLICK

535.343.2 : 548.7

3050. The optical transmission of additively coloured alkali halide crystals in the visible and near infra-red. H. FRIEDMAN AND C. P. GLOVER. Letter in *J. Opt. Soc. Amer.*, **39**, 795–6 (*Sept.*, 1949).

Excess alkali metal introduced photochemically, electrolytically or by exposure to metal vapour, produces *F*-centres. These have an absorption band whose peak varies between 4 200 Å (KF) and 7 000 Å (KI). For high concentration of *F*-centres the absorption extends somewhat beyond 1 μ for KBr; this may form a useful infrared transmitting filter. G. F. LOTHIAN

535.343.2 : 548.7

3051. Light absorption by KCl crystals with excess K and added $CaCl_2$. G. HEILAND AND H. KELTING. *Z. Phys.*, **126** (*Nos* 7–9) 689–96 (1949) *In German.*

It is already known that KCl crystals which contain Ca^{++} ions in addition to a stoichiometric excess of K can exhibit 3 absorption bands. A fourth band, with a max. at 5 400 Å, which gives a clear red colour to the crystals is now described. It is ascribed to Ca centres which do not move in an electric field, but which with rising temp. give rise to colour centres wandering to the anode. The effect of simultaneous presence of Ca^{++} ions and of colour centres on the conductivity of KCl crystals has been measured. C. B. ALLSOPP

535.343.2–15

3052. Theory of dispersion of molecular crystals in the infrared region. A. S. DAVYDOV. *J. Exp. Theor. Phys., USSR*, **19**, 930–6 (*Oct.*, 1949) *In Russian.*

Owing to interaction between molecular and lattice vibrations an additional absorption band occurs of higher frequency than the corresponding molecular vibration. A quantitative change in the dispersion curve arises in which the symmetry characteristic for dilute gases is lost. The results apply at low temperatures for ideal periodic crystal structure. J. JACOBS

535.343.2–15

3053. The infra-red spectra of liquid and solid methane. R. B. HOLDEN, W. J. TAYLOR AND H. L. JOHNSTON. Letter in *J. Chem. Phys.*, **17**, 1356 (*Dec.*, 1949).

535.343.3–14 : 539.133

3054. Nuclear and molecular information from the microwave spectrum of FCl. D. A. GILBERT, A. ROBERTS AND P. A. GRISWOLD. Letter in *Phys. Rev.*, **76**, 1723 (*Dec.* 1, 1949).

Rotational lines $J = 0 \rightarrow 1$ in FCl^{35} and FCl^{37} near 30 000 Mc/s for the lowest two vibrational levels are recorded; they are triplets as the electric quadrupole moment splits the lines $J = 1$. Hyperfine structure requires extra term in the Hamiltonian due to a magnetic field of 70 gauss at the Cl nucleus. Molecular electric dipole moment and other derived molecular constants are listed. The FCl bond is 80% covalent, 20% ionic. J. JACOBS

535.343.32

3055. Spectral changes of dyes in colloidal solutions of hydrous oxides. B. CARROLL AND A. W. THOMAS. Letter in *J. Chem. Phys.*, **17**, 1336 (*Dec.*, 1949).

535.343.32–

3056. Infra-red spectra of uranyl salts. A. I SEVCHENKO AND B. I. STEPANOV. *J. Exp. Theo Phys., USSR*, **19**, 1113–20 (*Dec.*, 1949) *In Russian.*

The spectra of 4 uranyl salts were investigated the range 5–14 μ. A great number of harmonics ar composite frequencies were established which can interpreted by the fundamental frequencies ν_1 830 cm^{-1}; $\nu_2 = 200\ cm^{-1}$; $\nu_3 = 920\ cm^{-1}$. Fro the comparison of the intensities of the bands wi the selection rules it follows that the ion UO_2^{++} the uranyl-sulphate and potassium sulphate uranyl has a curved form, whereas in uranyl aceta and uranyl nitrate it is almost linear. The influen of crystal water on the relative intensities of t individual bands was established: it does not affe the frequencies. B. F. KRA

535.343.4 : 551.539

Atmospheric absorption of heat radiation by wat vapour. *See Abstr.* 3574

535.343.4 : 551.593

Spectrophotometric studies on the transparency a hazy atmosphere. *See Abstr.* 3590

535.343.4 : 551.593

The transmission of the atmosphere in three regio of the visible spectrum. *See Abstr.* 3589

535.343.4–1

3057. Molecular spectroscopy. The inversio spectrum of ammonia. N. CARRARA, P. LOMBARDIN R. CINI AND L. SACCONI. *Nuovo Cim.*, **6**, 552– (*Nov.* 17, 1949) *In Italian.*

A description of a simple apparatus in which the ga under investigation is admitted at low pressure into waveguide along which f.m. microwaves are pr pagated. The absorption lines are examined on c.r.o. L. PINCHERL

535.343.4–1

3058. The microwave spectrum of chloroacetylen and deuterochloroacetylene. A. A. WESTENBER J. H. GOLDSTEIN AND E. B. WILSON, JR. *J. Chem Phys.*, **17**, 1319–21 (*Dec.*, 1949).

535.343.4–1

3059. Microwave spectrum and molecular constant of hydrogen cyanide. J. W. SIMMONS, W. E. ANDER SON AND W. GORDY. *Phys. Rev.*, **77**, 77–9 (*Jan.* 1 1950).

Precision measurements of the frequencies of th $J = 0 \rightarrow 1$ transition of $HC^{12}N^{14}$, $HC^{13}N^{14}$, $DC^{12}N^{1}$ and $DC^{13}N^{14}$ have been made. The B_0 and values are, respectively: 44 300·83 Mc/s and $18 \cdot 93_{79}$ $\times 10^{-40}$ g cm² for $HC^{12}N^{14}$; 43 154·83 and $19 \cdot 44_{08}$ for $HC^{13}N^{14}$; 36 207·40 and $23 \cdot 17_{108}$ for $DC^{12}N^{1}$ 35 587·57 and $23 \cdot 57_{465}$ for $DC^{13}N^{14}$. The inter atomic distances determined are $d_{CH} = 1 \cdot 061$ Å an $d_{CN} = 1 \cdot 157$ Å. The nuclear quadrupole couplin of N^{14} is determined as $4 \cdot 58 \pm 0 \cdot 05$ Mc/s. A

535.343.4–1

3060. *l*-type doubling in polyatomic molecules an its application to the microwave spectrum of methy cyanide and methyl iso-cyanide. H. H. NIELSEN *Phys. Rev.*, **77**, 130–5 (*Jan.* 1, 1950).

The theory of the *l*-type doubling for polyatomi molecules is developed and applied to explain certai anomalies observed in the microwave spectrum o

H_3CN and CH_3NC. The theory predicts for the nsition $J = 1 \rightarrow J = 2$, $\Delta K = 0$, where the mole-le is in an excited e vibration state, a pattern nsisting of 2 lines separated by about 100 Mc/s th 2 lines near the centre of this doublet which are out 2 or 3 Mc/s apart. The predicted patterns can made to agree quantitatively with the observed tterns by correcting the degenerate Coriolis term r centrifugal distortion. A.

535.343.4–14

61. Dispersion in NH_3 in the microwave region. . Birnbaum. Letter in *Phys. Rev.*, **77**, 144–5 (*Jan.* 1, 50).

535.343.4–14

62. Microwave spectrum of CH_2CFCl. J. K. ragg, T. C. Madison and A. H. Sharbaugh. tter in *Phys. Rev.*, **77**, 148–9 (*Jan.* 1, 1950).

535.343.4–14

63. Erratum: a theory of pressure absorption. . Mizushima. Letter in *Phys. Rev.*, **77**, 149 *an.* 1, 1950).

Some numerical values are corrected. [See Abstr. 3 (1950)].

535.343.4–14

64. A preliminary report on the fine structure of e microwave absorption spectrum of oxygen. J. H. rkhalter, R. S. Anderson, W. V. Smith and . Gordy. Letter in *Phys. Rev.*, **77**, 152–3 (*Jan.* 1, 50).

535.343.4–14

65. Microwave investigations of chloroform. . V. Smith and R. R. Unterberger. Letter in *Chem. Phys.*, **17**, 1348 (*Dec.* 7, 1949).

535.343.4–15

66. On the infra-red absorption of the hydrogen olecule. M. Mizushima. Letter in *Phys. Rev.*, **77**, 0–1 (*Jan.* 1, 1950).

535.343.4–15

67. Intensity of absorption lines in the infra-red. Vincent. *J. Phys. Radium*, **11**, 1–11D (*Jan.*, 1950) *French.*

A review. Summarizes Einstein's theory of the solute intensities of emission and absorption; entions the various methods of developing this uation, and gives in some detail that of Pauling id Wilson. Various attempts to apply this to tation-vibration bands are described. The deriva-on of absolute absorption intensities from measure-ents is discussed, and Paschen's method of correcting r finite slit widths is given. Various absolute easurements on bands of HCl, CO_2 and CO are ven. Includes 63 references. G. F. Lothian

535.345.6

68. A frustrated total reflection filter for the fra-red. B. H. Billings and M. A. Pittman. *Opt. Soc. Amer.*, **39**, 978–83 (*Dec.*, 1949).

This transmission band-pass filter can be con-ructed for any part of the spectrum for which there ist transparent materials of different indices of fraction. Measurements are shown of a filter hich was designed for the rocksalt infrared region. has two oppositely polarized pass bands which, a particular angle of incidence, are at $4\frac{1}{2}$ and 5 μ, spectively. Both the pass bands are approximately $\frac{1}{10}$ μ wide. They can be shifted over a range of approx. $\frac{1}{2}$ μ by tilting the filter. A.

535.361.11

3069. The diffuse reflection and transmission of light by a flat layer of a turbid medium. V. V. Sobolev. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 3) 353–6 (1949) *In Russian.*

A new method of solving the classical problem. F. Lachman

535.37

3070. The fluorescence of zinc sulphide activated with copper. F. A. Kröger, J. E. Hellingman and N. W. Smit. *Physica*, **15**, 990–1018 (*Dec.*, 1949).

The fluorescence consists of 3 bands: a green band and a blue band caused by Cu, and the blue band of self-activated ZnS. In addition to fluorescence centres, Cu may also give rise to quencher centres. The fluorescence centres have an absorption band associated with them, situated at the long-wave end of the fundamental absorption of ZnS. The variation in the relative concentration of the various centres with the conditions of preparation has been studied. The physical behaviour of the system is discussed on the basis of the Schön–Klasens theory of energy transfer between centres. A.

535.371

3071. Luminescence of phosphors with a laminated crystal lattice. G. P. Balin. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 1) 33–6 (1949) *In Russian.*

535.371

3072. Some characteristics of the luminescence of ZnS . Mn phosphors. N. A. Tolstoĭ and P. P. Feofilov. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 2) 285–8 (1949) *In Russian.*

Under certain physical conditions and at a definite concentration of Mn the luminescence of ZnS . Mn phosphors under the action of an exciting source of light of constant intensity differs from the normal luminescence in that it does not increase regularly to a constant value, but reaches a sharp max. and then falls to a value corresponding to stationary brightness. A Hg lamp with filters was the source of light. This phenomenon was observed only within a narrow range of Mn concentration, and only in the yellow Mn band of the luminescence. Increasing the intensity and length of excitation increases the relative brightness, while on lowering the temp. from room temp. to that of liquid air the phenomenon disappears. The effect can also be observed visually. The possible application of theories developed by V. L. Levshin (*J. Exp. Theor. Phys., USSR*, **17**, 676 (1947)] is discussed, although a physical mechanism cannot be advanced for the effect. W. Hughes

535.371

3073. The stimulation of the emission of phosphors by temperature. V. V. Antonov-Romanovskiĭ. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 3) 457–60 (1949) *In Russian.*

A theory based on the assumption of localization levels characterized by different energy depths is suggested to explain the successive maxima and minima in the emission of light by excited phosphors when their temperature rises steadily. The number of maxima in the curve of temperature stimulation gives

an idea of the number of groups of local levels differing in depth. At higher temperatures fewer electrons will be found at shallow levels than at deep ones. It has been deduced that the number of electrons at shallow levels decreases relatively with the fall of temperature, although the total number of electrons increases. It has been suggested that the energy absorbed by a phosphor during excitation is spent not only on ionizing the luminescence centres and heating the phosphor itself, but also on liberating the electrons from their localization centres. Thus, each electron can be liberated thermally or optically, the more probable way being always realized.

F. LACHMAN

535.371

3074. Effects of perturbations on phosphorescence: luminescence of metal organic complexes. P. YUSTER AND S. I. WEISSMAN. *J. Chem. Phys.*, **17**, 1182–7 (*Dec.*, 1949).

Fluorescence and phosphorescence spectra, phosphorescence lifetimes, and relative ratios of intensities of fluorescence to phosphorescence of the dibenzoylmethane derivatives of the trivalent ions of Al, Sc, Y, La, Gd and Lu have been measured. The lifetimes and intensity ratios of the various compounds differ widely, while the spectra are very similar. The results are interpreted in terms of Lewis's triplet theory of the phosphorescent state and spin-orbit perturbation of the levels. The largest effect is produced by the paramagnetic Gd ion. The effects produced by the non-magnetic ions depend on their nuclear charge and on their electronic structure. A.

535.371

3075. Interpretation of experimental decay curves of the phosphorescence of sulphides. D. CURIE. *C.R. Acad. Sci., Paris*, **229**, 1321–3 (*Dec.* 14, 1949) *In French.*

A further development of Saddy's work [*C.R. Acad. Sci., Paris*, **228**, 2022 (1949)] leading to the conclusions that there are two distributions, the deeper one having a Gaussian spread and giving a monomolecular decay. The shallower distribution indicates the intervention of a bimolecular process in which it is suggested that retrapping plays a part.

J. EWLES

535.371

3076. Review of articles on luminescence for 1949. G. R. FONDA. *J. Electrochem. Soc.*, **97**, 3C–7C (*Jan.*, 1949).

55 references.

535.372

3077. Investigation of the change of absorption at the excitation of phosphors. L. I. ANIKINA AND V. V. ANTONOV-ROMANOVSKIĬ. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 4) 669–72 (1949) *In Russian.*

Alkaline-earths phosphors activated with rare earths have been examined. Instead of the usual distinct absorption band of the centres of colour, having one maximum in the visible region, a band with a maximum in the i.r. has been observed as well as continuous absorption extending from the visible region down to $\sim 0{\cdot}3\,\mu$. For the SrS–Ce, Sm phosphor the additional absorption is $\propto$ the stored light sum. This result is in agreement with a theory suggested by Antonov-Romanovskiĭ [Abs 5349 (1949)].

F. LACHM

535.

3078. Luminescence of barium–strontium oxi R. E. AITCHISON. Letter in *Nature, Lond.*, **1** 1088 (*Dec.* 24, 1949).

Under electron bombardment a pale blue fluor cence is observed extending from 4 600–5 40 with max. at 4 900 Å. The intensity decreases as temp. rises, the fall being rapid above 700°K. luminescence is observed above 800°K. A. H. W. BE

535.

3079. Effect of thermal history on color of z beryllium silicate (Mn) phosphors. S. JONES. *Electrochem. Soc.*, **97**, 25–8 (*Jan.*, 1950).

535.

3080. An ultraviolet-emitting phosphor. V. ZELINSKIĬ AND T. V. TIMOFEEVA. *Dokl. Akd Nauk, SSSR*, **66** (*No.* 2) 187–9 (1949) *In Russian.*

535.

3081. Ultraviolet emitting phosphor. R. NA R. W. WOLLENTIN AND C. K. LUI. *J. Electroch Soc.*, **97**, 29–32 (*Jan.*, 1950).

A CaZn phosphate phosphor activated with has been developed for the generation of u.v. rad tion and is especially rich in erythemal region. T peak of emission of this phosphor is dependent up the ratio of the Ca to Zn. A phosphor in which of Ca is replaced by Zn in Ca phosphate has a pe emission at 3 120 Å, or very near that of maximu erythemal effectiveness. 40 W fluorescent lam made with this new phosphor in ultraviolet tra mitting glass (9 821) produced between 7·5 to 8·7 of ultraviolet radiations between 2 800 Å and 3 80 with a peak emission at 3 120 Å. The weigh erythemal effective radiation from this lamp is fr 1 300 to 1 750 mW, or about 2½ times the effect erythemal radiation from Ca phosphate activat with Tl.

535.3

3082. Zinc sulfide infrared quenching phospho N. T. MELAMED. *J. Electrochem. Soc.*, **97**, 3 (*Jan.*, 1950).

The i.r. quenching bands of ZnS, activated by and by Mn, Fe, Ni, or Co, were measured. Th were found to be the same for each of the latter activators. They are, therefore, attributed to t presence of Cu. The quenching bands of Cu-activat ZnS are similar to the stimulation bands of C activated ZnS containing either Pb or Mn. stimulation and quenching are, therefore, believ to result from the same process. From measureme of photoconduction and the effect of CdS on i quenching, the quenching bands are shown to due to both deep and shallow traps associated w the auxiliary activator. A model is proposed t these traps.

535.3

3083. The fluorescence of silver halides at l temperatures. I. The pure halides. G. C. FARNE P. C. BURTON AND R. HALLAMA. *Phil. Mag.*, 4 157–68 (*Feb.*, 1950).

Fluorescence emission spectra of AgCl, AgBr a

I, believed to be characteristic of the pure solids, ve been recorded at liquid N and liquid H temps. e spectra are all in the visible and lie just to the g wavelength side of the absorption bands of the pective halides. No resolution of the spectra was served down to the lowest temp.; no pure halide cimen emitted any phosphorescence or thermal erglow. The two different structures of AgI able of existence at ordinary and low temps. urtzite and zincblende) gave slightly different ission spectra. The temp. at which the fluorescence t became visible was about 180°K for AgCl and I, but only 77°K for AgBr. Excitation of the orescence could be effected by any wavelength ich the halide was capable of absorbing. All 3 lides emitted an extra band in the red after being posed to light action at ordinary temp., or slightly composed by heat treatment, so as to give a dis- rsion of free Ag in the halide. Large quantities of purity (~ 1–3 M%) were required in order to er appreciably the characteristic emission of the sic Ag halide. The low-temp. fluorescence of the re halides is believed to be due to the direct recom- nation of excited electrons with positive holes with emission of visible radiation, instead of the ission of thermal quanta as at higher temps. A.

535.375.5

84. Raman spectra of methyl methacrylate glass. M. PATEL. Letter in *Curr. Sci.*, **18**, 436–7 (*Dec.*, 49).

535.375.5

85. The vibrational spectra and structure of the minum hydride ion. E. R. LIPPINCOTT. Letter in *Chem. Phys.*, **17**, 1351 (*Dec.*, 1949).

535.375.5

86. Structure of concentrated aqueous solutions metallic nitrates. J.-P. MATHIEU AND M. LOUNS- RY. *C.R. Acad. Sci., Paris*, **229**, 1315–16 (*Dec.* 14, 49) *In French.*

The Raman spectra of the nitrates of Li, Ca, Al, and Th in concentrated solution and in the drated crystalline state are compared and simi- ities are discussed. W. R. ANGUS

535.375.5

87. Second order Raman-spectra of NaBr and crystals. A. I. STEKHANOV AND M. L. PETROVA. *Exp. Theor. Phys., USSR*, **19** (*No.* 12) 1108–12 ec., 1949) *In Russian.*

The 2nd-order Raman spectra of NaBr and KI re obtained. The law of the temperature-depen- nce of the 2nd-order spectra was verified on the aBr crystal. B. F. KRAUS

535.375.51

88. Structure of the zones near the exciting line the combination scattering of light [Raman spectra] formic acid and of methyl alcohol. P. D. SIMOVA. kl. Akad. Nauk, SSSR, **69** (*No.* 1) 27–8 (1949) *In ssian.*

A diffuse region of the methyl alcohol Raman ectrum was shown to consist of 3 lines at 235, 264 d 296 cm^{-1}, and the differences of about 30 cm^{-1} e assigned to the frequency of H deformation out the O—H . . . O line. A similar combination of the H deformation and a fundamental frequency explains the lines at 148, 170, 200 and 230 cm^{-1} in a diffuse region of the liquid formic acid spectrum.

D. H. WHIFFEN

535.377

3089. A kinetic study of the thermoluminescence of lithium fluoride. C. A. BOYD. *J. Chem. Phys.*, **17**, 1221–6 (*Dec.*, 1949).

The isothermal decay of the thermoluminescence of single crystals of LiF activated by X-rays has been determined at various temps. The results are interpreted in terms of a simple reaction rate mechanism based on a picture of the thermoluminescent process similar to that of Johnson. The analysis of the isothermal decay studies is in agreement with the results of "glow curve" experiments on similar LiF samples where the intensity of luminescence is measured as the temp. of the crystal is heated at a constant rate. Two principal types of electron traps in LiF are found to have trapping energies of 19 800 cal/mole and 45 300 cal/mole respectively. A.

535.377 : 536.55

The observation of temperature distributions and of thermal radiation by means of non linear phosphors. *See Abstr.* 3129

535.39

3090. Calculation of the reflectivities and transmissions of interfering absorption-free multiple films. K. HAMMER AND O. V. MILLER. *Optik*, **5**, 365–70 (*Sept.*, 1949) *In German.*

It is shown that these values can be calculated in a simple manner by extending the classical Airy summation procedure. The formulae derived are applied to $\lambda/4$ films illuminated at normal incidence. Calculations are made for compound arrangements with alternate high and low μ. Reflectivities and transmissions are given for from 1 to 5 double layers of ZnS and cryolite on glass of $\mu = 1{\cdot}5$. Reflectivity increases progressively from 39·5 to 99%. The formulae given can be used for increasing the reflectivity of metal films with compound dielectric superposed layers. S. TOLANSKY

535.39

3091. Reflection from a multilayer filter. H. D. POLSTER. *J. Opt. Soc. Amer.*, **39**, 1038–43 (*Dec.*, 1949).

The solution of the multilayer filter is obtained as a boundary value problem. A recursion formula is developed, which, applied once for each layer, gives the reflected beam. A graphical means for determining the unknown quantity in the recursion formula has been shown to apply to dielectric layers. The solution has been used to explain an irregular fringe shift in the reflected pattern from an interferometer, one of whose plates has a uniform wedge of dielectric deposited on it. It is shown that this irregular shifting of the fringes with thickness of the dielectric must be considered if interferometric determinations of index of refraction are to be made. This method of determining the reflected beam has also been applied in finding the transmission characteristics of the frustrated total reflection filter. It is found that the width of the transmission band which, theoretically, could be arbitrarily small without loss of peak trans-

mission, is limited by the uniformity in the thickness of the spacer layer. A.

535.39

3092. A method for measuring extremely small non-uniformities in the optical thickness of evaporated films. A. E. Gee and H. D. Polster. *J. Opt. Soc. Amer.*, **39**, 1044–7 (*Dec.*, 1949).

Methods are described for measuring accurately the ½-widths of frustrated total reflection filters of very narrow pass bands, and for detecting extremely small non-uniformities in the spacer layers of these filters. The latter method, permitting observation and measurement of thin film non-uniformities appreciably < 1 unit cell provides a very sensitive means of studying thin film structures and the mechanism of formation. A.

535.39

3093. Theoretical explanation of certain optical properties of thin metallic films. D. Malé. *Rev. Opt. (Théor. Instrum.)* **29**, 27–31 (*Jan.*, 1950) *In French.*

The anomalous behaviour of thin metallic films can be explained by postulating a variation of the optical constants with thickness. The treatment is graphical. No comparison with experimental data is made. Graphs are given. R. A. WEALE

535.392

3094. Gloss measurement of papers: application of the Barkas analysis. V. G. W. Harrison. *Brit. J. Appl. Phys.*, **1**, 46–54 (*Feb.*, 1950).

The Barkas analysis is applied to a series of 9 papers of known visual gloss. With some reservations, the analysis is found to hold approximately and the distribution of mirror facets so derived is found to accord well with the surface structure of the papers as found by microscopic examination. It is concluded that, whilst the analysis is of negligible value for practical gloss determinations, it appears to present a useful method of investigating the surface structure and "finish" of paper and similar delicate materials. The gloss of the papers examined appears to be assessed solely by the intensity of the light reflected at the specular angle and not by the contrast noted by examination at different angles nor by the ratio of specularly-reflected to diffusely-reflected light. Some suggestions for future research are given. A.

535.393

3095. The reflectivity of some silver alloys in the near ultra-violet. M. M. Noskov and G. P. Skornyakov. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 6) 809–11 (1949) *In Russian.*

535.393

3096. A small portable reflectometer. W. Liben and N. W. Scott. Note in *Rev. Sci. Instrum.*, **20**, 960 (*Dec.*, 1949).

535.417

3097. A mount for a Perot–Fabry interferometer without etalon ring. H. Haber. Letter in *J. Opt. Soc. Amer.*, **39**, 1050–1 (*Dec.*, 1949).

535.417 : 531.717

3098. The measurement of the planeness of reflecting surfaces using fringes of equal thickness. R. Landwehr. *Optik*, **5**, 354–64 (*Sept.*, 1949) *In German.*

Exact formulae are derived for evaluating surface curvature from the curvature of fringes produced i a comparison plane. The formulae derived permit distinguishing between spherical and non-spheri deviations from a plane. The validity of the formu is discussed and limits of accuracy determined. T conditions required to be obeyed for the attainme of the given accuracy are discussed. Two nomogra are calculated which assist in evaluating curvatu of only very slightly curved surfaces. S. TOLANSK

535.4

3099. Polarization phenomena for diffraction at slit. W. Hartnagel and E. Kappler. *Z. Natu forsch.*, **4a**, 498–506 (*Oct.*, 1949) *In German.*

From observations on the polarization phenome a simple theory of the diffraction has been develope The theory assumes that the light traversing the s consists of two parts, one coming from the part of t slit between the jaws and the other proceeding from t slit jaws. For wide slits the first part predomina and has an intensity distribution identical with th given by the Kirchhoff diffraction theory: the sta of polarization is identical with that of the incide wave. The second part has a phase difference wi respect to the incident wave which differs for t π and σ components: the phase and intensity distrib tion depends on the shape, and the optical constan of the material of the slit. Experimental details a given of the method of observation, results are d cussed and photographs shown of the phenomena. H. G. JERRAR

535.542

3100. The formation of fringes in a Babinet com pensator. H. G. Jerrard. *J. Opt. Soc. Amer.*, 3 1031–5 (*Dec.*, 1949).

Details are given of the appearance of the field view when 2 wedges of doubly refracting material a placed in arbitrary azimuths between crossed polarizi devices. In general the field of view presents a co plex pattern but simple fringe systems appear f suitable orientation of the wedges, one of which is t well-known Babinet fringe system. Theoretic relationships are derived for the intensity distributi in the general case and for the simple cases. Phot graphs show how the simple fringe systems are form out of the complex cases. A use of the patterns f detecting if the wedges of a Babinet compensator a correctly mounted is mentioned.

535.

3101. Improvements in photoelastic technique o tained by the use of a photometric method. A. F. Brown and V. M. Hickson. *Brit. J. Appl. Phy* **1**, 39–44 (*Feb.*, 1950).

A photoelectric photometer has been adapted f use in photoelasticity. The sensitivity of the instr ment is such that a photoelastic stress pattern can measured to within $\pm$ 1/500 fringe. The resulta improvements in technique are: (1) the use of materi having less susceptibility to edge effects than the generally used, but with too low a stress-opti coefficient for examination by normal metho (2) the use of lower stresses which should be particular advantage in 3-dimensional stress analy by the frozen stress method, where lower stres

ould reduce the strains which are often excessive in his method; and (3) greater ease in tracing isoclinics because the photometer enables a distinction to be made between isoclinics and isochromatics. The apparatus is described, examples of its use are given and factors limiting its accuracy are discussed. A.

535.551

3102. The resolving power of a polarization apparatus for the investigation of stresses. M. F. Bokshteĭn (Bockstein). *J. Tech. Phys., USSR*, **19**, 1103–6 (*Oct.*, 1949) *In Russian.*

It has been shown that the lack of resolution in interference bands formed by a model under stress is caused by the deviation of light in the model at great stress gradients. An analogy has been established between this phenomenon and the diffraction of light by fine structure. F. LACHMAN

535.551 : 620.171.5

3103. A new method of stress-analysis by polarized light. A. V. Stepanov. *J. Tech. Phys., USSR*, **19** (*No.* 2) 205–17 (1949) *In Russian.*

It is proposed to analyse stress patterns in polarized light using models made of AgCl, a transparent crystalline substance, with mechanical properties and structure resembling that of the crystalline metals. Details of the method are given and its utility in the analysis of residual strains is demonstrated.

INDEX AERONAUTICUS

535.65

3104. On colorimetric standardization. H. E. J. Neugebauer. *Z. wiss. Photogr.*, **44** (*Nos* 10–12) 193–203 (1949) *In German.*

German colorimetric terms are discussed, and alterations in the nomenclature suggested. Reasons are advanced for the rejection of the CIE system by many who deal with colours (artists, psychologists, etc.). A modification of McAdam's [*J. Opt. Soc. Amer.*, **27**, 294 (1937)] chromaticity diagram is given, white forming the origin of the co-ordinate system. It is said to have the advantage that 4 fundamental stimuli (Urfarben) have zero ordinates or abscissae: their approximate wavelengths are 7 300, 5 700, 5 000 and 4 500 Å. Relevant advantages of Luther's system [*Z. Tech. Phys.*, **8**, 548 (1927)] are pointed out. R. A. WEALE

535.82

3105. Microscope for interferometric observation of translucent objects. V. A. Savin. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 2) 177–9 (1949) *In Russian.*

Previous attempts to combine a microscope with an interferometer, mainly for measurement of refraction coefficient of small crystalline bodies, did not permit the use of high magnification and large aperture. The instrument described overcomes these difficulties. A semi-opaque mirror separating two identical cemented prisms divides and directs the light beam via two micro-objectives of the same magnification and aperture so that the observed object is viewed with a minute interference discrimination, depending on the thickness of the object and its refraction coefficient. The instrument compares favourably with Zernicke's phase contrast microscope. A. LANDMAN

535.87

3106. Mirror for solar heating. H. Straubel. *Z. angew. Phys.*, **1**, 542–5 (*Dec.*, 1949) *In German.*

A paraboloidal mirror, 2 m dia. and 86 cm focal length, is found experimentally to be capable of producing a temp. at the focus high enough to melt TO_2, ZrO_2 and Al_2O_3 in about 10 sec. With favourable atmospheric conditions, the temp. is estimated at 4 000°C. N. CORCORAN

HEAT 536

536.212

3107. The effect of an electric field on the thermal conductivity of glass. C. E. Berry. Letter in *J. Chem. Phys.*, **17**, 1355 (*Dec.*, 1949).

536.22

3108. On heat transfer problems in viscous flow. G. F. Carrier and J. A. Lewis. *Quart. Appl. Math.*, **7**, 450–7 (*Jan.*, 1950).

Various methods are given for finding the temperature distribution throughout the field of flow. The types of problems which arise in practice are classified, and the flow between 2 parallel walls is examined in detail. L. S. GODDARD

536.221

3109. Conduction of heat with change of state. D. Geist and U. Dehlinger. *Z. Naturforsch.*, **4a**, 415–23 (*Sept.*, 1949) *In German.*

The boundary between solid and liquid in a cooling melt behaves like a moving heat source. The 1-dimensional heat equation is solved exactly for a source moving with constant velocity, and an approximation suitable for calculation is given for the region near the source. When the velocity depends upon the temp. the equation is transformed into an integral equation. Approximate solutions are found for the source velocity and position and the temp. near the source when its velocity is a linear function of temp. This is applied to molten Cu and molten NaCl. The results are graphed. It does not seem possible to explain the lammellar structure of crystals on the basis of these results without postulating improbable values for the velocity of the boundary. S. MICHAELSON

536.23

3110. The transport properties for non-polar gases. J. O. Hirschfelder, R. B. Bird and E. L. Spotz. Letter in *J. Chem. Phys.*, **17**, 1343–4 (*Dec.*, 1949).

536.24.01

3111. A problem of heat propagation treated with the method of functional operators. O. Garavaldi. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **6**, 461–6 (*April*, 1949) *In Italian.*

Heat is developed in an enclosure with a known law, and starting at $t = 0$. The external surface of the walls, whose conductivity and specific heat is given, is kept at 0. The law of variation of the temp. inside the enclosure was determined by solving with standard operational methods the equivalent electrical problem. L. PINCHERLE

536.24.01

3112. The temperature in an accreting medium with heat generation. A. E. BENFIELD. *Quart. Appl. Math.*, **7**, 436–9 (*Jan.*, 1950).

A Laplace transform method is used to solve the problem of the temperature distribution within a homogeneous semi-infinite medium, to which material is supplied at a constant rate and steady temperature.

L. S. GODDARD

536.24.01

3113. The role of radiation and associated phenomena in thermal transfer. W. DE GROOT. *Voordr. K. Inst. Ing.*, **2**, 74–84 (*Jan.*, 1950) *In Dutch.*

In many cases radiation plays an important part in heat transfer problems. For large objects, placed in air, radiation becomes appreciable in comparison with natural convection from about 80°C upward. The influences of radiation and natural convection in the heating of rooms are dealt with. The production of light and infrared radiation by incandescent lamps is discussed, as are some problems in connection with gaseous discharge lamps. In many cases (e.g. electronic valves) radiation is used as a means of energy dissipation. Inductive and capacitive heating by h.f. alternating fields may be considered as a limiting case of heat transfer by electromagnetic radiation. A.

536.24.01

3114. Discussion of some processes in which heat transfer takes place mainly by convection. H. A. LENIGER. *Voordr. K. Inst. Ing.*, **2**, 106–26 (*Jan.*, 1950) *In Dutch.*

Some general remarks on convection are made and the classification of convection processes is discussed briefly. The flow of gases through beds of granular materials is dealt with and the relationship between heat transfer and pressure drop is treated. Some investigations giving direct measurements of the heat transfer are mentioned. The paper concludes with a brief discussion of the heat transfer between a gas and a wet granular material. A.

536.241

3115. A method for determining certain critical masses. GOHEEN, H. E. *J. Math. Phys.*, **27**, 107–16 (*July*, 1949).

A method is described for calculating the critical size of a reacting substance required to sustain an exothermic reaction when it is set in an infinite matrix of the same substance at a temperature too low to sustain the reaction. Only the idealized cases of a sphere, an infinitely long and wide slab, and an infinitely long cylinder of the hot reacting substance are considered, where its heat capacity, density, and heat conductivity are assumed constant. The rate of heat generation per unit volume of reacting substance is taken to be a simple exponential function of its temperature, but the method can be applied if this is any analytic function of the temperature.

W. H. DENTON

536.42

3116. Resolution by calculation of total vapour pressure curves into partial pressure curves. I. Theoretical foundations and former methods. A. MUSIL AND E. SCHRAMKE. *Acta Phys. Austriaca*, **3** (*Nos* 2–3) 137–45 (1949) *In German.*

The constants α_2 and α_3 occurring in the solution of the Duhem–Margules differential equation can l used to calculate the free enthalpy of binary mixture From this free enthalpy and the experimentally dete mined enthalpy of mixing (negative heat of mixing) is possible to calculate the entropy of mixing. Devi tions from Raoult's law and their effect on the co stants α_2 and α_3 are considered. Former metho of calculating α_2 and α_3 from the total vapour pressu curve, in particular the methods of Margule Zawidzki, of Marshall, Bose and Story, and Joukovsky, are reviewed. The last-mentioned meth is considered to be unsatisfactory. A. J. M

536.421.1 : 537.311.3

3117. Physical properties of polonium. I. Melti point, electrical resistance, density, and allotrop C. R. MAXWELL. *J. Chem. Phys.*, **17**, 1288–92 (*Dec* 1949).

Measurements of these quantities are reporte An abrupt change in the electrical resistance ne 100°C indicates that Po exists in two allotropic form Observations which indicate that the temp. for cryst transformation is a function of the size and history the specimen are reported.

536.423 : 535.32

Physical properties of sixty hydrocarbons. *Se Abstr.* 3027

536.424 : 548.736

X-ray study of thermal transformations in mag nesian chlorite minerals. *See Abstr.* 3540

536.46 : 531.57

3118. Remarks on the relation between the explosion temperature of a colloidal propellant and its rate burning. H. MURAOUR AND G. AUNIS. *C.R. Acad Sci., Paris*, **229**, 749–51 (*Oct.* 17, 1949) *In French.*

In a previous paper [*C.R. Acad. Sci., Paris*, **22** 381 (1947)] the authors showed that a linear relatio exists between log B and T (where B is the rate burning and T the explosion temp. in °K). The valu of T was obtained by assuming that the evolution energy from the propellant takes place at const. vo and that the products of combustion are in a state thermal equilibrium. Values of T have now bee calculated on the basis of 8 other assumptions. Thes may be classified into 3 groups: (*a*) C burns to CO excess C remaining free; (*b*) H burns to H_2O, exce O giving CO_2, CO, and free C depending on th amount of excess O available; (*c*) N burns first to NO which oxidizes C and H in various ways. It is foun that the linear relation between log B and T still exis when T is calculated on any of these assumption whether the burning process takes place at cons vol. or at const. pressure. A. SCHOFIEL

536.4

3119. Optical methods for the determination flame temperatures. II. Reversal methods for no isothermal flames, two-path method, compensate hot-wire method, methods based on measurement line intensities. S. S. PENNER. *Amer. J. Phys.*, **1** 491–500 (*Nov.*, 1949).

A general review continued [see Abstr. 1725 (1950)] Application of Na-line reversal to 2 isothermal flam or a composite flame is described. The 2-path metho is suitable for pulsating flames; the spectral brightne temperatures for a direct light beam and for a bea

flected back through the flame yield the emissivity nd flame temperature. Measurements from rota- onal intensity distribution in band spectra, and nitations due to lack of equilibrium in flame gases e discussed. A. G. GAYDON

536.46

120. Measurements of normal burning velocities nd flame temperatures of Bunsen flames. J. W. NDERSEN AND R. S. FEIN. *J. Chem. Phys.*, **17**, 268–73 (*Dec.*, 1949).

Stroboscopically illuminated particle tracks are used measure normal burning velocities of laminar ames accurately. The precision of the measurements increased by the use of a constant-velocity profile ozzle which gives a straight-sided Bunsen cone. ormal burning velocity data are presented for ·7 to 5·3% propane–air mixtures. The value for the oichiometric flame was determined to be 44·8 cm/sec. rom stroboscopic and streak photographs of particle acks it is possible to obtain the maximum flame mperature and temperature distribution in the flame ont. Measurements from the 2 types of photo- raphs are combined with the equation of continuity nd the equation of state to obtain the flame temp. he temp. for a stoichiometric propane–air flame as determined to be 2 220°K. An extension of this ethod is used to obtain an approximation of the mp. distribution in the flame front. A.

536.48

121. The viscosity of mixtures of He^3 and He^4. . TER HAAR AND H. WERGELAND. *Phys. Rev.*, **75**, 36 (*March* 1, 1949).

On Tisza's picture the total viscosity is the sum of kinetic and a dynamic viscosity. Assuming that the atter remains unaltered, the authors estimate the hange in viscosity due to small admixtures of He^3 He^4 liquid assuming (*a*) kinetic viscosities are dditive, (*b*) the kinetic viscosity of He^3 is due to the ero-point momentum associated with a Fermi- irac gas. R. B. DINGLE

536.48

122. The viscosity and thermal conductivity of ixtures of He^3 and He^4. K. S. SINGWI AND L. S. OTHARI. Letter in *Phys. Rev.*, **76**, 305–6 (*July* 15, 949).

In these calculations further account is taken of he fact that He^3 obeys Fermi–Dirac statistics. The alues obtained are > those given by Ter Haar and Vergeland [preceding Abstr.]. R. B. DINGLE

536.48

123. Effect of He^3 on the λ-point of He^4. O. K. IICE. Letter in *Phys. Rev.*, **77**, 142–3 (*Jan.* 1, 1950).

536.51

124. Heat-conduction errors in temperature easurements. L. E. SMITH. *Trans. Amer. Inst. Mech. Engrs*, **72**, 71–6 (*Jan.*, 1950).

In practical applications of temp. measurements here the temp.-sensitive bulb assembly is fastened igidly to a containing vessel, heat-conduction errors ust be considered in order to determine the accuracy f the indicated or recorded temp. This paper resents for various thermometer-bulb assemblies, the experimental magnitude of the heat-conduction error possible in a medium with a low heat-transfer coeff. (air), and in a medium with a high heat-transfer coeff. (water). The effect of heat-conduction error on the overall response in simulated practical installations is discussed. It is shown that comparative information on response action of any type of temp.-sensitive element necessitates careful considerations of the condition of attaching the element to a wall or vessel, where heat-conduction effects are present. A.

536.52

3125. A portable radiation pyrometer. P. R. MARSHALL AND D. K. MACKENZIE. *J. Sci. Instrum.*, **27**, 33–6 (*Feb.*, 1950).

The behaviour of PbS photo-conductive cells is briefly discussed and the construction of a portable radiation pyrometer using such a cell is described. The pyrometer has been used to measure flash temps. produced by brake applications on moving vehicles. The instrument incorporates c.r.o. presentation and its response to flashes of radiation of duration down to 1 msec is within ±0·5 db of the response to steady radiation from the same source. The lowest measurable temp. of a surface of emissivity 0·3 is 200°C. A.

536.53

3126. Sensitivity of Schwarz–Hilger thermopiles. E. SCHWARZ. Note in *Rev. Sci. Instrum.*, **20**, 962 (*Dec.*, 1949).

536.531

3127. Platinum resistance thermometers of small dimensions. C. R. BARBER. *J. Sci. Instrum.*, **27**, 47–9 (*Feb.*, 1950).

A method of constructing a small Pt resistance thermometer is described in which a formerless coil is contained in a fine glass U-tube. The outer glass sheath is about 6 mm in diameter and is hermetically sealed. The lag constant of the thermometer is 5 sec. It is shown that the reproducibility of R_0 over the range from −180 to 600°C is ±0·001°C. A.

536.531.5 : 621.317.39.082.64

3128. Heating error in resistance thermometers. F. LIENEWEG. *Arch. tech. Messen, Issue No.* 165 (*Ref. JO*23–4) T87–8 (*Oct.*, 1949) *In German.*

The current passing through a resistance thermometer during a measurement will heat the thermometer to a certain extent and thereby cause an error in the reading. The actual temp. rise depends on the current magnitude, the actual construction of the thermometer, the thermal conductivity of the surrounding medium and the thermal exchange between the thermometer and the surrounding medium. All these points are considered in some detail, graphs showing the magnitudes of the various effects. E. H. DOCK

536.55 : 535.377

3129. The observation of temperature distributions and of thermal radiation by means of non-linear phosphors. F. URBACH, N. R. NAIL AND D. PEARLMAN. *J. Opt. Soc. Amer.*, **39**, 1011–19 (*Dec.*, 1949).

It is shown that the temp.-dependence of the luminescent efficiency of numerous phosphors may

be used for the observation, measurement and recording of temps. and temp. distributions. Remarkably high sensitivities can be obtained. Two methods are described: in the first, the surface to be observed is coated with a luminescent material and evenly illuminated with u.v. radiation. The temp. distribution on the surface of the object under test becomes visible as a pattern of brightness or colour of the luminescent coating. In the second method, a temp.-sensitive phosphor screen is placed in the focus of a suitable optical system. An image of the distribution of the thermal radiation from the object becomes visible on the screen as a brightness pattern. While the second method does not require any coating of the object, the first is by far the more sensitive. A number of pictures illustrating the two methods and a discussion of their performance are given. A.

536.62

3130. Direct calorimetry by means of the gradient principle. T. H. Benzinger and C. Kitzinger. *Rev. Sci. Instrum.*, **20**, 849–60 (*Dec.*, 1949).

A rapidly responding calorimeter for continuous recording of biological heat exchange is described. The method is based on the enclosure of the subject in a shell completely lined with a uniform heat flow metering layer ("gradient layer") while ventilatory and respiratory heat losses are determined in heat exchange meters based on the same technique. The measurement comprises in one thermoelectric potential the sum of all components of heat loss (radiant, convective, conductive and evaporative fractions). Partitioning measurements of respiratory and evaporative heat losses are readily obtained. Environmental conditions can be closely controlled and widely varied. The gradient calorimeter with its rapid response (time lag 42 sec) is specifically designed for studies of reflex mechanisms involved in temperature control. It is, however, suggested that the characteristics described will, in general, encourage wider application of direct calorimetry in experimental and clinical studies. A.

536.631

3131. Results of low temperature research. VII. The molar heats of the alkali halides LiF, NaCl, KCl, KBr, KI, RbBr, RbI from 10° to 273° abs. K. Clusius, J. Goldmann and A. Perlick. *Z. Naturforsch.*, **4a**, 424–32 (*Sept.*, 1949) *In German.*

Measurements on single crystals in a vacuum calorimeter. No salt gives a constant value of the Debye θ. For LiCl, NaCl, KCl, which could be measured for sufficiently low values of T/θ, θ has a minimum at $T \simeq \theta/12$ which corresponds to the pseudo T^3 range of Blackmann. All salts, in particular those of low θ, have a maximum of θ at high temperatures. The calculations of Kellermann [Abstr. 1317 (1941)] for NaCl and Iona [Abstr. 902 (1942)] for KCl, which are based on Born's lattice theory, give excellent agreement both regarding shape and absolute value of the θ (T) curve. The practical usefulness of the Debye formula for extrapolating the thermodynamical quantities to absolute zero remains unimpaired by the present results, if one uses the θ values valid for 10°K. H. LONDON

536.6

3132. Electronic specific heats in tungsten and zin A. A. Silvidi and J. G. Daunt. *Phys. Rev.*, 7 125–9 (*Jan.* 1, 1950).

Calorimetric measurements have been made in t liquid He temp. region on W and Zn. For W, t specific heat could be resolved into a lattice function with Debye $\theta = 169°$K and an electron term γT with $\gamma = 51{\cdot}1 \times 10^{-4}$ cal/mole/degree^2. Tl anomalously low θ-value may indicate the existen of a hidden transition at low temps. A discussion given of the high value of γ and it is suggested th a recalculation of the energy spectrum at both hig and low temps. may be required and that correlatio forces may be partly responsible for the observe result. For Zn, measurements were also carrie out on a powder with average particle size $= 1{\cdot}3$ 10^{-4} cm in order to assess the significance of si effects. The results showed that the powder had specific heat identical with that for Zn in bulk, give by a Debye $\theta = 291°$K and an electronic term γ with $\gamma = 1{\cdot}50 \times 10^{-4}$ cal/mole/degree^2.

536.633.3 : 533.7

3133. Measurement of the ratio of the principa specific heats of a gas. G. A. Harle. Letter i *Nature, Lond.*, **165**, 74 (*Jan.* 14, 1950).

The pressure-time relationship as a gas is allowe to effuse through an orifice into a previously evacuate enclosure is observed. The pressure p at which th linear relationship ceases is given by $\log p = [\gamma/(\gamma - 1)] \log [2/(\gamma + 1)] + \log P$, where P is th pressure outside the chamber. This critical pressur is observed by the audible introduction of turbulenc at the transition point. The value of γ for air can b obtained to 1%. F. E. HOAR

THERMODYNAMICS 536.7/.8

536.71 : 532.7

3134. Some properties of van der Waals' liquids F. T. Wall and W. R. Krigbaum. *J. Chem. Phys.* **17**, 1274–8 (*Dec.*, 1949).

A theoretical consideration of the volume of a va der Waals' liquid suggests some new rules, comparabl to that of Trouton, relating coeffs. of expansion an compressibility to heats of vaporization. Accordin to the simplest and most reliable of these new relation ships, the product of the coeff. of cubical expansio and the heat of vaporization, $\alpha \Delta H_v$, is the same fo many liquids and equal to about 10 cal/deg. It i further shown that at a given temp., $\Delta H_v^2 \beta / V$ is als constant where β is the compressibility and V th volume of the liquid. Certain corollary rules ar derived by combining the above two with each othe and with Trouton's law. These new rules shoul prove of some value in estimating compressibilitie and heats of vaporization from coeffs. of expansion A

536.71 : 532.7

General equations for the orthobaric densities a functions of the reduced temperature. *See Abstr.* 296

536.76 : 533.15

35. The thermal effect of diffusion in gases. E. VERSCHAFFELT. *Bull. Acad. Roy. Belg. Cl. Sci.*, (*No.* 10) 869–79 (1949) *In French.*

In the movement of a stream of gas temp. variations se from pressure changes. These variations cannot cessarily be calculated from the Poisson formula. ren if there is no exchange of heat with the surundings the flow is not, properly speaking, adiabatic. equalities of temp. tend to be effaced by thermal nduction and it is shown that only when the effects this and of radiation are negligible does the ordinary iabatic relation hold. Equations are deduced for e thermal effect in a gas changing its composition diffusion. These results are compared with those eviously deduced by Waldmann. They are not in reement. F. E. HOARE

536.76 : 533.15

36. On the thermomechanics of mixed fluids. E. VERSCHAFFELT. *Bull. Acad. Roy. Belg. Cl. Sci.*, (*No.* 10) 847–68 (1949) *In French.*

Complementary to previous work the case of the riable state of a fluid mixture which is not at rest in e system is considered. Previous work by igogine is discussed and results compared. Wholly athematical. F. E. HOARE

536.77

37. Continuum models of cooperative phenomenon. W. MONTROLL. *Nuovo Cim.*, **6** (*Suppl. No.* 2) 55–78 (1949).

The Ising model of an atomic system, in a generaled form which includes the spherical and Gaussian odels, is treated as a continuum problem, and rmulae for the specific heat are derived.

P. M. DAVIDSON

ELECTRICITY 537

LECTROSTATICS . DIELECTRICS 537.2

537.226

38. On Onsager's theory of polarization of dipole iquids. V. I. ODELEVSKIĬ. *Dokl. Akad. Nauk, SSR*, **69** (*No.* 3) 349–51 (1949) *In Russian.*

Onsager calculated energy as function of the angle arting from the rotation moment; this is shown to e unnecessary. Calculations by Onsager's method the active part of the energy which affects the ngular distribution of dipoles are compared with sults of scalar multiplication of the electric moment nd the polarizing field. An extra term arises as nsager's model ignores interaction of constant fixed poles and dispersion forces. An improved value is und for the dielectric permeability of water.

J. JACOBS

537.226

39. Time dependence of electronic processes in electrics. H. FRÖHLICH AND J. O'DWYER. *Proc. hys. Soc., Lond. A*, **63**, 81–5 (*Feb.*, 1950).

In solid dielectrics electrons may be excited from low levels into conduction levels or into traps with energies slightly lower (shallow traps) by an ionizing radiation or by the action of strong fields. It is assumed that collisions amongst electrons in these levels are so frequent that an electronic temp. T is established which may be different from the lattice temps. Also the number of electrons in these levels need not correspond to equilibrium at temp. T, in which case transitions to or from lower levels (of lattice defects or foreign admixtures) will take place. Such transitions are either due to excitation by sufficiently fast moving electrons in the conduction levels, or to the inverse process. In this way it is possible to account for recombination within a reasonable time provided these lower levels (denoted as deep traps) are not $\geqslant 1$ eV below the lowest of the shallow traps. The difficulty of having to introduce recombination with simultaneous emission of very many vibrational quanta, an extremely unlikely process, is thus avoided. Other applications of this method, for example to the time dependence of electronic conductivity in strong fields, are indicated.

A.

537.226.2

3140. Ferroelectricity in the ilmenite structure. B. T. MATTHIAS AND J. P. REMEIKA. Letter in *Phys. Rev.*, **76**, 1886–7 (*Dec.* 15, 1949).

$LiTaO_3$ and $LiCbO_3$ single crystals were found to be strongly ferroelectric showing saturation polarization which increases rapidly with temp.

A. L. MACKAY

537.226.2 : 535.324

Dielectric constants of liquids and gases under pressure. *See Abstr.* 3028

537.226.2 : 538.221

The properties of ferromagnetic compounds at centimetre wavelengths. *See Abstr.* 3265

537.226.2 : 538.221

3141. Dimensional effects resulting from a high dielectric constant found in a ferromagnetic ferrite. F. G. BROCKMAN, P. H. DOWLING AND W. G. STENECK. *Phys. Rev.*, **77**, 85–93 (*Jan.* 1, 1950).

A variety of a ferromagnetic ferrite is shown to have dielectric properties corresponding to a dielectric constant of the order of 10^5. Coupled with a magnetic permeability of about 10^3, this leads to dimensional resonance effects such that the apparent permeability of a core whose section is $2{\cdot}5 \times 1{\cdot}25$ cm reduces to very low values in the region of 2 Mc/s. An apparent anomaly exists in the dielectric behaviour in the vicinity of the magnetic Curie point. A general theory of dimensional effects encountered in measuring magnetic and dielectric constants is developed. This theory is based on the geometry of the infinite slab. When the theory is applied to the ferrite under study, a residual variation of the permeability with frequency remains, which may be explained by magnetic resonance. The theory accounts adequately for the dielectric effects at the Curie point. A.

537.226.2 : 621.315.618.9

3142. The dielectric strength of gaseous fluorocarbons. W. A. WILSON, J. H. SIMONS AND T. J. BRICE. *J. Appl. Phys.*, **21**, 203–5 (*March*, 1950).

The 60 c/s dielectric strengths of some gaseous

fluorocarbons have been measured between three differently shaped electrode pairs at pressures up to 3 atm. The breakdown potentials for propforane, butforane and pentforane were found, in most instances, to be $\geqslant$ those for SF_6 under comparable conditions, and to be $\gg$ those for N_2. Fluorocarbons thus have possible uses as gaseous insulators in high voltage apparatus. A.

537.226.2 : 621.317.335.3 : 621.315.614

3143. Dielectric properties of some animal tissues at meter and centimeter wave lengths. E. R. LAIRD AND K. FERGUSON. *Canad. J. Res. A*, **27**, 218–30 (*Nov.*, 1949).

Measurements were made of the permittivity and the absorption coefficient of some animal tissues at 1·72 m by the Drude–Cooledge method, and at 9·5 cm and 3·2 cm by the reflection with change of phase method as developed by von Hippel. The permittivity of beef fat changed from about 9·5 at 1·72 m to 3·5 at 3·2 cm, that of bone remained about constant between 6·5 and 7, that of beef bone marrow was reduced from 20 to 3·7, and that of frog muscle from 135 to 35. The absorption coefficient increased from 0·026 to 0·79 per cm for fat, from 0·0028 to 0·56 for bone, from 0·028 to 0·9 for bone marrow, and from 0·08 to between 5 and 6 for frog muscle in the same range. Uncertainties of measurement and variation between samples are in general large. The permittivity found for muscle at 1·72 cm is $>$ a value given by Osswald at 3 m. A.

537.226.2 : 666

3144. The dielectric properties of glass and their structural interpretation. W. A. WEYL. *J. Soc. Glass Tech.*, **33**, 220–38T (*Aug.*, 1949).

The dielectric properties of glasses are determined by electronic and atomic polarization processes which are not different from those encountered in crystalline solids. In addition, however, glasses show a phenomenon which formally may be described as "orientation polarization." This phenomenon is the result of some of the glass constituents being mobile even at room temp. and the fact that the open structure of glasses offers alternative positions for these ions. The removal of a Na ion from its original position into a neighbouring "hole" produces a domain which has the electrical properties of a dipole. In external force fields these dislocations of Na ions do not remain random, but are directed by the field. As a result, such a glass becomes anisotropic and may be described as containing oriented dipoles. The number of these units, the height of the energy barriers separating the different potential wells and the thermal energy available for overcoming these potential barriers are the factors which determine the dielectric properties of glasses. The response of a glass in an external electrical field affects the average internuclear distance. As a result, the volume of a glass changes with the strength of the field applied (electrostriction). The additional motion of atoms which result from their assuming new equilibrium positions in the electrical fields is responsible for the power loss, i.e. the change of electrical energy into heat. There exists a parallelism between the response of a glass to external electrical and to external mechanical fields. It is emphasized that previous attempts to treat these phenomena on the basis mathematical equations led to convenient ways describing them in another language but not to explanation.

537.226.3 : 621.317.335 : 621.315

3145. The application of a new method of inves gating relaxation processes to the study of the relaxat polarization of dielectrics. G. I. SKANAVI, N. TOLSTOĬ, P. P. FEOFILOV AND K. I. LEBEDEVA. *J. E Theor. Phys., USSR*, **19**, 1121–9 (*Dec.*, 1949) *Russian.*

Square pulses were applied through a resistance a capacitor containing the dielectric under investi tion and to a similar circuit containing a standa capacitor. The voltages from the capacitors w applied to the *X* and *Y* plates of a c.r.o. and deviatio from "elastic" charging were shown by non-linear of the trace. Relaxation times of 10^{-6} to 10^{-1} could be observed. TiO_2 with 1·25% of alkali earth oxide was thus studied at temperatures betwe −183° and 100°C. The behaviour of this dielect can be represented by an equivalent circuit compos of a pure ("elastic") capacitance which is shunted two series combinations of R and C with differe time constants to correspond to two ionic diffusi processes. [See Abstr. 2493, 4447 (1949)].

A. L. MACK

537.22

3146. The influence of piezo-electrification tribo-electrification. J. W. PETERSON. Letter *Phys. Rev.*, **76**, 1882–3 (*Dec.* 15, 1949).

Details are given of an investigation to test wheth certain cases of tribo-electrification are due to t transfer of charge to any surface touching the charg face of a strained piezo-electric crystal. It is co cluded that piezo-electrification is not importa [See Abstr. 5418 (1949)]. H. G. JERRA

537.29 : 535

On the influence of electric fields on the spreadi of light rays. *See Abstr.* 3026

ELECTRIC CONDUCTION . CURRENTS 53

537.3 : 5

The fluctuation process as vibration with randd amplitude and phase. *See Abstr.* 2852

537.3 : 621.396.611.3 : 621.

3147. Level of the electrical fluctuations in oscillating circuit. E. YA. PUMPER. *Dokl. Aka Nauk, SSSR*, **66** (*No.* 1) 41–4 (1949) *In Russian.*

537.31

3148. The electrical properties of the intermeta compound Mg_2Sn. B. I. BOLTAKS. *Dokl. Aka Nauk, SSSR*, **64** (*No.* 5) 653–6 (1949) *In Russian.*

537.31

3149. Electric conduction of very thin coatings platinum at liquid helium temperatures. P. LAI B. VODAR, N. MOSTOVETCH, M. BARBARON A R. SPÖNDLIN. *C.R. Acad. Sci., Paris*, **229**, 815– (*Oct.* 24, 1949) *In French.*

Extension of previous measurements [ibid., 22

7–8 (*Jan.* 12, 1948)]. A very high negative temperature coefficient of the resistance was found. At high fields a departure from Ohm's law occurred. Adsorption of He caused a decrease of the resistance.

H. LONDON

537.311.3

150. Theory of the electric resistivity of polycrystalline graphite. D. BOWEN. Letter in *Phys. Rev.*, **76**, 1878 (*Dec.* 15, 1949).

The resistivity of polycrystalline graphite exceeds that of single crystals. It is governed by the anisotropy of individual crystallites, their size and orientation, and by electron scattering at crystallite boundaries. Both contributions and their temp. dependence can be calculated. H. K. HENISCH

537.311.31

151. Some notes on the properties of metal–ammonia solutions. J. W. HODGINS AND E. A. FLOOD. *Canad. J. Res. B*, **27**, 874–7 (*Nov.*, 1949).

Some experiments are described that corroborate earlier observations of minute persistent currents in frozen rings of solutions of Na in NH_3. It is shown, however, that it is unlikely that these currents are due either to superconductivity of the solid or to orientation of crystals in the magnetic field. Comment is made on the presence of two liquid phases in Na–NH_3 solutions. A.

537.311.31

152. Some properties of cesium–ammonia solutions. W. HODGINS. *Canad. J. Res. B*, 861–73 (*Nov.*, 1949).

Measurements of vapour pressure, liquid density and electrical conductance were made on solutions of Cs in liquid NH_3. The solutions differ from those of the other alkali metals in that there is no indication of liquid–liquid phase separation for concentrations 0·04 *N* to 7 *N*. Experiments on rings of solution frozen in liquid N make it appear unlikely that the system is superconducting at 77°K. A.

537.311.31 : 669.295

153. The preparation and some properties of ductile titanium. H. W. WORNER. *Metallurgia, Manchr*, **40**, 4 *pp.* (*June*, 1949).

The density and elect. resistivity of Ti are found to be 4·51 and 55×10^{-6} ohm cm. The temp. coeff. of resistance is $35\cdot5\times10^{-4}$.

537.311.33

154. On the theory of the conductive mechanism in cadmium sulphide crystals. I. BROSER, H. KALLMANN AND R. WARMINSKY. *Z. Naturforsch.*, **4a**, 31–7 (*Nov.*, 1949) *In German.*

A model is proposed which takes account of the connection between conductivity and luminescence. The efficiency of luminescence phenomena is observed to increase with conductivity. Both properties are a function of impurity content and of the life-time of the charge carriers. Many crystals have high electron multiplication factors under light or nucleon bombardment. This process is often associated with pronounced inertia. In highly activated CdS excitation by α-particles is most effective near the cathode. Photo-conductive properties are influenced by preillumination of the crystal before application of the electric field. These and other observations are accounted for by assuming that a narrow partially filled band exists below the main conduction band of the crystal. H. K. HENISCH

537.311.33

3155. Non linear I–V characteristics of Ge at very low temperatures. F. K. DU PRÉ. Letter in *Phys. Rev.*, 77, 152 (*Jan.* 1, 1950).

537.311.33

3156. Characteristics of compound barrier layer rectifiers. E. BILLIG AND P. T. LANDSBERG. *Proc. Phys. Soc., Lond. A*, **63**, 101–11 (*Feb.*, 1950).

The assumptions involved in Mott's and Schottky's theories of rectification are analysed and a potential barrier at the metal–semiconductor interface is proposed which enables one to pass continuously from one theory to the other. The model is directly applicable to the practically important case of rectifiers possessing an additional insulating layer between semiconductor and counter-electrode. The current–voltage characteristic of such a compound barrier is obtained and contains Mott's and Schottky's results as special cases. In this connection, an expression for the volume distribution of current carriers is obtained and plotted for the case of a linear potential distribution in the barrier. A discussion of the distribution of charges throughout the rectifier leads naturally to the concept of a capacitance of the barrier, and to the derivation of the capacitance–voltage characteristic. In this connection, a definite experimental problem is suggested by the analysis. A.

537.311.33 : 548.7

3157. Electrons in perturbed periodic lattices. J. C. SLATER. *Phys. Rev.*, **76**, 1592–601 (*Dec.* 1, 1949).

It is shown that the motion of an electron in a periodic potential, such as is found in a solid, plus a slowly varying perturbative potential, can be derived from the energy in the periodic lattice alone, as a function of momentum or wave number. A Schrödinger equation is set up, in which the Hamiltonian is the sum of this energy in the periodic lattice—the momentum being replaced by a differential operator—and of the perturbative potential energy. The resulting wave function modulates atomic functions to provide a solution of the perturbed problem. This method is applied to give proofs of simple theorems in conduction theory, to discuss the energy levels of impurity atoms in a semiconductor, and to consider excitons; all are problems which have been considered before, but which are treated more straightforwardly by the present method. Applying the method statistically, the combined Poisson's equation and Fermi–Dirac statistics are set up for impurities in metals and semiconductors, and for the theory of rectifying barriers. A.

537.331.33 : 548.7

3158. Electronic states in perturbed periodic systems. H. M. JAMES. *Phys. Rev.*, **76**, 1611–24 (*Dec.* 1, 1949).

The occurrence in perturbed periodic systems, such as impure crystals, of localized states with discrete energies is discussed from both qualitative and quantitative points of view. Semiclassical considerations, modified in the usual way by wave concepts, make it clear that impurities will give rise to impurity

states above or below corresponding permitted bands of energy, according as the ionic charge of the impurity is less than or greater than that of the ion it replaces. Localized states at crystal interfaces and free surfaces can be discussed in the same way. Consideration of the behaviour of wave packets leads to formulation of the effective-mass wave equation of Peckar. Complete solutions of the perturbed-periodic wave equation are then constructed by joining together solutions valid for a single period of the unperturbed potential. When the perturbation is slowly varying (though not necessarily small in its total effect) this approach leads to an analytic solution of the problem involving errors of the order of the ratio of the change in the perturbation potential across a single cell to the total kinetic energy of the particle. The effective-mass equation appears in connection with an approximate form of this solution, but the relation of its solution $\phi(x)$ to the correct wave function $\psi(x)$ is more complex than has previously been realized. To construct $\psi(x)$ in any small region one should resolve $\phi(x)$ locally into the sum of two exponentials $C \exp\{\pm (i/\hbar)p_d x\}$, multiply each by the appropriate periodic function, and add the results. A quadratically integrable $\phi(x)$ corresponds to a quadratically integrable $\psi(x)$ with the same energy; thus stationary-state energies determined by solving the effective-mass wave equation are found to be surprisingly reliable. A.

537.311.33 : 621.314.63.014

3159. D.c. characteristics of silicon and germanium point contact crystal rectifiers. I. Experimental. H. J. YEARIAN. *J. Appl. Phys.*, **21**, 214–21 (*March*, 1950).

Typical d.c. current/voltage characteristics obtained for Si and Ge crystal rectifiers are described. A survey of the published theories of the rectifier shows that none of them will account for the principal features of the observed characteristics. The most obvious discrepancy is in the low-resistance direction of flow where the log (current) rises with increasing voltage at only a fraction of the rate indicated by the theories. The need for a more flexible theory is pointed out and the conditions which it must meet, both as a function of voltage and temperature, are outlined. A.

537.312.5

3160. The initial stages of the relaxation of the photoconductivity of Bi_2S_3. D. B. GUREVICH, N. A. TOLSTOĬ AND P. P. FEOFILOV. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 3) 365–8 (1949) *In Russian.*

537.312.62

3161. The high frequency resistance of superconductors. A. B. PIPPARD. *Physica*, **15**, 40–4 (*April*, 1949).

Report on earlier work [Abstr. 3541 (1947)], including some new results at 9 200 Mc/s. The latter do not agree with the theory of Reuter and Sondheimer [Abstr. 1032 (1949)]. H. LONDON

537.312.62

3162. The high frequency skin resistance of metals at low temperatures. A. B. PIPPARD. *Physica*, **15**, 45–54 (*April*, 1949).

Report on earlier work [Abstr. 3542, 3543 (1947); *Nature, Lond.*, **162**, 68 (1948)] also on theoretic work by Reuter and Sondheimer [Abstr. 1032 (1949)] H. LONDO

537.312.

3163. Superconductivity. C. J. GORTER. *Physic* **15**, 55–64 (*April*, 1949).

A short review of the phenomenological theories superconductivity since 1934, with particular referen to thermodynamics, thermal conductivity and therm electric effects. It is stressed that the understandi of the latter still presents great difficulties.

H. LONDO

537.312.

3164. Change of superconducting properties thallium under pressure. L. S. KAN, B. G. LAZAR AND A. I. SUDOVTSOV. *Dokl. Akad. Nauk, SSS* **69** (*No.* 2) 173–4 (1949) *In Russian.*

The transition temperature of Tl was found to increased by hydrostatic pressure ($\sim 0{\cdot}02°K$ f about 1 700 kg/cm²). The sign of the effect is opposi to that previously found in Sn, In, Pb, Hg, Ta.

D. SHOENBER

537.312.

3165. Change of volume of tin in the superconducti transition in a magnetic field. B. G. LAZAREV AN A. I. SUDOVTSOV. *Dokl. Akad. Nauk, SSSR,* (*No.* 3) 345–7 (1949) *In Russian.*

$\Delta V/V$ was measured by means of a bimetallic str of brass and Sn 4 m long calibrated at higher tem peratures by the known thermal expansions. ΔV fell from 9×10^{-8} at $1{\cdot}4°K$ to zero at the transitio temperature; the whole curve of $\Delta V/V$ against T w in excellent quantitative agreement with the predi tions of thermodynamics. D. SHOENBER

537.312

3166. The influence of a magnetic field on t electrical resistance of ferromagnetic alloys of M and Sb. I. G. FAKIDOV AND N. P. GRAZHDANKIN *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 5) 847–9 (194 *In Russian.*

537.312

3167. Variation of the electrical resistance of superstructural alloy in a longitudinal magnetic fie R. G. ANNAEV. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 1071–4 (1949) *In Russian.*

ELECTRIC DISCHARGES 537.52

537.523 : 621.3.015

3168. Electric breakdown in CO_2 from low pressur to the liquid state. D. R. YOUNG. *J. Appl. Phys* **21**, 222–31 (*March*, 1950).

Paschen's similarity law is verified for low pressure At high pressures small departures are observed f long gap-lengths and large departures for small ga lengths. Simultaneously the scatter of the breakdow voltage becomes independent of illumination and t breakdown strength dependent on the catho material; this appears to be due to the onset of fie emission. Measurements of pre-breakdown curren yielded values for Townsend's first coefficient as w

for the field emission constants. For small gap-lengths the pre-breakdown currents are > the normal field emission equation predicts, indicating some new process effective at short gap-lengths. The transition from the gaseous to the liquid state does not produce a discontinuous change of the breakdown voltage. A.

537.523.4 : 535.33.03

Alteration of spectral character of sparks with time. *See Abstr.* 3030

537.523.5

3169. Immobility phenomena and reverse driving phenomena of the electric arc. S. YAMAMURA. *J. Appl. Phys.*, **21**, 193–6 (*March*, 1950).

When an electric arc is driven by a magnetic field, under special conditions, curious phenomena are observed. An electric arc cannot be driven by the magnetic field when it is established at very small gaps between the electrodes, nor for the instant just after the contacts have been broken. These phenomena are called immobility phenomena. The immobility time and the driving velocity of the electric arc were measured under various air pressures. As the air pressure decreases, the immobility time increases and the driving velocity decreases. Under a certain low air pressure, the arc cannot be driven by the magnetic field. When the air pressure is lower than this critical value, the arc can be driven again by the magnetic field; but in this case, the arc moves in a direction that is opposite to the direction of the electromagnetic force. The causes are considered. A.

537.523.5 : 621.791.75

3170. The temperature distribution of the welding arc. F. OLLENDORFF. *Bull. Ass. Suisse Elect.*, **40**, 898–903 (*Nov.* 12, 1949) *In German.*

The conditions governing the heat distribution set up by an arc moving at a constant speed along a straight seam in a plate of thickness (d) and of sufficient length and width for those dimensions to be treated as infinite, are formulated into a partial differential equation. Applying Newton's Theorem to the heat transfer between the upper and lower faces of the plate and the surrounding air, and assuming the gradient over d to be negligible, the integration is developed and the general analytical result illustrated by 3 isothermal charts of specific cases of the stationary and moving arc. Correcting the oversimplification implied in the original assumption of an infinitesimal arc dia. a cylindrical zone of fusion is substituted at this stage and the average temperature within its radius identified with the melting temperature of the material. This renders possible the definition of losses and process efficiency in terms of heat transfer through the zone boundaries, leading to mathematical expressions for those quantities which are shown with a numerical example. J. H. O. SMERD (R)

537.525.8 : 537.563

3171. A mass-spectrometer probe method for the study of gas discharges. R. L. F. BOYD. *Nature, Lond.*, **165**, 142–4 (*Jan.* 28, 1950).

Describes a new method for studying positive and negative ion populations in low pressure gaseous discharges. A probe, in which is incorporated an r.f. filter system, with a nose dia. ~ 1 cm, is moved radially through the discharge and enables radial variations of, e.g., negative ions to be studied. The system in effect is equivalent to a very small time-of-flight mass spectrometer of novel type. Some preliminary data for O^- and O_2^- in O_2 ($p \simeq 16$–$27\ \mu$, tube current $\simeq 0{\cdot}1$–$1{\cdot}2$ mA). J. D. CRAGGS

537.528 : 534.222.2

Investigations on spark sound waves by means of X-ray flashes. *See Abstr.* 2990

537.529

3172. The time delay in conduction and breakdown processes in amorphous solids. J. H. SIMPSON. *Proc. Phys. Soc., Lond. A*, **63**, 86–100 (*Feb.*, 1950).

A method of estimating the time delay in changes of conductivity and in the breakdown process for amorphous materials, based on Fröhlich's high-temp. breakdown theory, is given. Numerical values of these times are obtained for the case of soda-lime glass, and it is estimated that the time constant of the conduction process is between 10^{-4} and 10^{-5} sec, while that of the breakdown process may be considerably shorter. Experimental data obtained by Turner and Lewis indicate that the estimate for the conductivity process is of the correct order. A.

537.529 : 548.7

3173. On the theory of electron multiplication in crystals. F. SEITZ. *Phys. Rev.*, **76**, 1376–93 (*Nov.* 1, 1949).

The theory of the multiplication of electrons in strong electrostatic fields is investigated. It is found that the non-polar coupling between electrons and lattice has an important effect on the retardation of electrons in polar materials as well as in non-polar ones if the electron is to be accelerated to an energy at which it may ionize the bulk material. The retardation arising from this coupling is a maximum when the energy of the electron corresponds to a value near the boundary of the Brillouin zone, in contrast with the retardation arising from purely polar interaction in polar crystals which has its maximum when the energy is near the energy of the polar modes. The existence of the non-polar interaction seems to make the difference between the breakdown criteria of von Hippel and Fröhlich of less practical importance than was supposed hitherto. It is found that statistical fluctuations in the velocity of the electrons plays a very important role in determining electron multiplication and that the field required to produce breakdown in a standard specimen actually is no more than 20% of the value obtained from the criteria of von Hippel and Fröhlich. A.

X-RAYS 537.531

537.531 : 535.343

3174. On the fine structure near the Fe K-absorption edges in the various oxides of Fe. D. COSTER AND S. KIESTRA. *Phil. Mag.*, **41**, 144–51 (*Feb.*, 1950).

After a review of the theoretical interpretation of the fine structure in X-ray absorption edges, new measurements on the K-edges of different compounds of Fe at low dispersion are described. From these in

conjunction with earlier measurements at high dispersion [Abstr. 2485 (1948)] the following conclusions may be drawn: (*a*) In a region up to about 70 eV from the edge the behaviour of the absorption coeff. is mainly a property of the atom in question. (*b*) In a region between 70 and 175 eV the fine structure is determined by the immediate surroundings of the atom. (*c*) In the region above 175 eV the fine structure depends essentially on the crystal lattice. This is in accordance with the notion that as the energy of the ejected electron increases it penetrates further into the lattice. A.

537.531 : 535.4

3175. On the phenomena of the variability of the angle of diffraction and of square-edged lines occurring in [back-reflection] Debye–Scherrer lines. F. Lihl. *Acta Phys. Austriaca*, **3** (*Nos* 2–3) 156–83 (1949) *In German.*

Earlier explanations of the variation in the Bragg angle of individual diffraction maxima given by a stationary coarse-grained specimen are reviewed and rejected. Total reflection of the beam on a suitably oriented free crystal surface is a satisfactory explanation both of the intensity and the distribution of the maxima. The sharp boundary occasionally observed on the long- or short-wave side of the highest-order line is similarly explained. The explanation was tested by experiments in which the roughness of the specimen surface was varied. A. J. C. Wilson

537.531 : 535.4

3176. Instrument for measurement of X-ray diffraction patterns. J. A. Bennett. *Rev. Sci. Instrum.*, **20**, 908–10 (*Dec.*, 1949).

An instrument is described for measuring X-ray back reflection patterns for surface stress determinations. Its chief feature is a curved slit in the optical system so that the beam of light which scans the diffraction ring is an arc having the same radius of curvature as the ring. This instrument has been found to be at least as precise as a microphotometer for these measurements and its use has resulted in a considerable saving of time. It is suggested that the instrument might appropriately be called a photomicrometer. A.

537.531 : 535.43

3177. Coherent scattering of X-rays by atoms with more than one electron according to the one-electron theory and the positron theory. E. Arnous. Letter in *Phys. Rev.*, **77**, 149 (*Jan.* 1, 1950).

537.531 : 541.141

The action of X-rays on benzene and benzoic acids. *See Abstr.* 3464

537.531 : 541.141

The action of X-rays on some amino-acids. *See Abstr.* 3466

537.531 : 548.7

The action of X-rays on KCl crystals. *See Abstr.* 3513

537.531 : 621.386.7

3178. A fractional microsecond X-ray pulse generator for studying high explosive phenomena. H. I. Breidenbach, Jr. *Rev. Sci. Instrum.*, **20**, 899–903 (*Dec.*, 1949).

An X-ray pulse generator capable of producing short bursts of X-rays not $> 3\times10^{-7}$ sec in duratio has been constructed. These short bursts are obtain by supplying a negative 50 kV, 12·5 Joule trigg pulse to the cathode shield of a standard Westin house W.L. 389-flash X-ray tube. This pul generates a pre-discharge plasma in the tube whi blocks the main 100 kV, 290 Joule pulse until t cathode-to-anode gap impedance is lowered ionization. An arrangement is also describe whereby 3 separate, successive radiographs of a sing detonation may be taken at predetermined tim intervals.

537.531 : 77.0

Quantum efficiency in photographic X-ray exposure *See Abstr.* 3624

537.531 : 778

3179. Spectral analysis of 10-Mev betatron radiatio by nuclear emulsion. P. K. S. Wang and M. Wiene Letter in *Phys. Rev.*, **76**, 1724–5 (*Dec.* 1, 1949).

The spectrum of the X-radiation emitted by 10 MeV betatron has been measured by recordi the proton tracks from the photodisintegration of in nuclear track emulsions. These were soaked D_2O for 20 min at 25°C and were then expos simultaneously with a control soaked in H_2O f $0{\cdot}3\,r$. 2 000 proton tracks were counted on the D_2 loaded against 30 on the H_2O loaded plate. Fro the longest ranges of proton tracks observed it concluded that the max. photon energy is 11 Me A formula for the spectral distribution of the numbe of proton tracks to be expected from the cross-sectio for photodisintegration is derived within angul limits and the related X-ray spectral intensity shown in histograms. A comparison with t theoretical histogram according to calculations Schiff, based on Bethe–Heitler's theory shows discrepancy at the low energies (< 4 MeV) which assumed to be partially due to the difficulty in findi the short proton tracks. An excess of the exper mental values at the high energies is found whic parallels results obtained by Fuller [Abstr. 498 (1950)] R. H. Her

CATHODE RAYS . POSITIVE RAYS 537.533/.53

537.533.7

3180. Design curves for 180° magnetic spectro meters. G. E. Owen. *Rev. Sci. Instrum.*, **20**, 916–2 (*Dec.*, 1949).

The image shapes resulting from 180° focusing c charged particles in a homogeneous magnetic fiel have been computed. General curves are presente in terms of 3 variables for variable ρ-spectrometer (as in the case of photographic detection) and i terms of 4 variables for constant ρ-spectrometers a in the case of detection with a fixed counter). Th variables are source and exit-slit height, source width angular selection, and exit-slit width. The advantage of using sources and exit-slits with a large dimensio parallel to the magnetic field (i.e. height) are noted.

537.533.72

81. Focusing in a semicircular magnetic spectro-ter. C. M. FOWLER, R. G. SHREFFLER AND J. M. ORK. Note in *Rev. Sci. Instrum.*, **20**, 966–7 (*Dec.*, 49).

537.533.72

82. The theory of the independent electrostatic ns with three diaphragms ["einzellinse"]. E. REGEN-REIF. *C.R. Acad. Sci., Paris*, **229**, 1311–13 (*Dec.* 14, 49) *In French.*

Derives an analytical expression for the potential an einzellinse consisting of 3-plane parallel elec-odes with circular apertures by superposing the otentials due to each plate. The constants are termined by requiring that the potentials remain ntinuous as the hole radii $\to 0$. Good agreement ith trough measurements is obtained.

A. H. W. BECK

537.533.72

83. Electron optics of the three stage electron icroscope. C. E. CHALLICE. Letter in *Proc. Phys. oc., Lond. B*, **163**, 59–61 (*Jan.*, 1950).

The approximate positions and methods of for-ation of the image were examined by Gaussian ptics. Figures are given illustrating the various onditions which can be obtained. A. H. W. BECK

537.533.72 : 539.165

184. Concerning the question of the resolving ower of a magnetic spectrograph. G. D. LATYSHEV, . A. MALEV and M. V. PASECHNIK. *Izv. Akad. auk, Ser. Fiz.*, **13** (*No.* 4) 421–7 (1949) *In Russian.*

537.533.72 : 539.165.08

185. An intermediate image β-spectrometer of gh transmission. H. SLÄTIS AND K. SIEGBAHN. *rk. Fys.*, **1**, *Paper* 17, 339–57 (1949).

A new type of lens spectrometer is described using he focusing properties of an axial magnetic field ith strong magnetic field gradient; it gives excep-onally high intensity at good resolving power (e.g. or resolving power of 4%, about 8% of the total diation is transmitted). By tracing electron paths ith a photographic method (using ThB *F*-line ectrons) it was found that an intermediate ring-haped image is formed, the final image being a oint. The position of the sample and the field radient require critical adjustment. A.

537.533.72 : 539.165.08

186. Double magnetic lens nuclear spectrometer. L. M. AGNEW AND H. L. ANDERSON. *Rev. Sci. nstrum.*, **20**, 869–73 (*Dec.*, 1949).

A large double magnetic lens spectrometer has been onstructed for the study of γ- and β-ray spectra. he magnetic field is produced by two identical oaxial water-cooled coils, each 10·2 cm wide, 1·7 cm I.D., 73·7 cm O.D., and spaced 95·6 cm part. The source is placed on the axis at the centre f one coil and the detector is placed on the axis at he centre of the other. The instrument is charac-erized by a large transmission with moderate resolu-on. Scattering is virtually absent because of the ature of the trajectories which are used, and because he large dimensions have made possible the removal f scattering material to a considerable distance from the source. The design has lent itself easily to the application of accelerating voltages at the detector admitting the detection of β-rays down to 1 kV. The maximum energy conveniently studied with the present arrangement is 2·8 MeV. Be-coated Zapon films of thickness 0·01 mg/cm² have been used to mount sources. Charge does not accumulate on these sources. Observations with a Cs^{137} source 4 mm in diameter have shown a transmission of 1·4% with a resolution of 1%. The appearance of the internal conversion and Auger electron lines testifies to the absence of appreciable scattering. A.

537.533.72 : 621.385.833

3187. An electromagnetic focusing device for the electron microscope. H. T. MERYMAN. Note in *Rev. Sci. Instrum.*, **20**, 955 (*Dec.*, 1949).

537.533.72 : 621.385.833 : 621.317.329

3188. The field in an electron-optical immersion objective. L. JACOB. *Proc. Phys. Soc., Lond. B*, **63**, 75–83 (*Feb.*, 1950).

The electrolytic tank method was developed to record rapidly the potential variations which occur in the field of the immersion objective in the absence of space charge. The axial distribution over the region explored was found to conform with a law of the form $V = Ae^{kz}$. [A is a voltage scale factor, k a geometrical scale factor.] The experimental results appear to show that for constant black-out voltage the gradient at the cathode remains constant over part of the range explored, independent of geometry. The ratio of accelerator to modulator voltage for zero gradient at the cathode varies inversely as the square of the hole diameter. A determination of the emitting area of the cathode was also made from the field plots. A.

537.533.73

3189. The diffraction of successively flying [poocheredno letyashchikh] electrons. L. BIBERMAN, N. SUSHKIN AND V. FABRIKANT. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 2) 185–6 (1949) *In Russian.*

537.533.73 : 548.74

3190. Influence of the focusing of the electron beam on the fineness of the diffracted rays. H. BILDE AND J. DEVAUX. *C.R. Acad. Sci., Paris*, **230**, 215–17 (*Jan.* 9, 1950) *In French.*

The usual arrangement, with the electron beam coming to a focus on the film, focuses the diffracted rays on the film only if the plane of the specimen is perpendicular to the beam. Focusing in a restricted part of the film can be obtained with inclined specimens by altering the point of focus of the incident beam; e.g. for glancing-angle photographs the point of focus is above the level of the specimen.

A. J. C. WILSON

537.533.74

3191. Reactive corrections for the elastic scattering of an electron. S. ENDÔ, T. KINOSHITA AND Z. KOBA. *Progr. Theor. Phys.*, **4**, 218–29 (*April–June*, 1949).

The radiative correction to the scattering of an electron in an electrostatic potential is evaluated by subtraction methods, and also by the use of the *C*-meson field, treating the *C*-meson as a real particle. No appreciable difference is discovered. H. MCMANUS

537.533.74

3192. Thompson scattering and the hole theory. D. S. KOTHARI AND F. C. AULUCK. Letter in *Phys. Rev.*, **76**, 433 (*Aug.* 1, 1949).

In support of the contention of Halpern and Hall [Abstr. 5939 (1949)] that ordinary electron theory and the hole theory can give different results, it is stated that the two theories give different results for the scattering of an electron when it is a constituent of a degenerate Fermi gas. G. J. KYNCH

537.533.74

3193. Radiative reaction and damping in scattering. J. HAMILTON. *Proc. Phys. Soc., Lond. A*, **62**, 749–62 (*Dec.*, 1949).

The higher order radiative corrections and the damping corrections to the cross-section for the scattering of an electron by an electrostatic potential are investigated. It is shown that the perturbation treatment of the radiative corrections at high frequencies joins on to the Bloch–Nordsieck solution for low frequencies. The damping effect arising from the low frequency photons is shown to be negligible, and a modified damping equation is proposed which gives a smooth transition to the damping correction in passing from high to low frequency photons. A.

537.533.74

3194. Applications of the Peierls–McManus classical finite electron theory. J. IRVING. *Proc. Phys. Soc., Lond. A*, **62**, 780–90 (*Dec.*, 1949).

In the case of an electron in a high-frequency field of small amplitude it is found that the scattering cross-section for radiation depends only on the mechanical mass m, instead of the total mass, as in the point electron theory. For the scattering of fast electrons by "protons" the differential cross-section for scattering depends on the mass in a more complicated way. Finite values are obtained for the deflection for all values of the impact parameter and for the total energy radiated in the collision. A.

537.533.75

3195. Straggling of electrons near the critical energy. II. L. EYGES. *Phys. Rev.*, **77**, 81–5 (*Jan.* 1, 1950).

The straggling of electrons with energy near the critical energy is discussed, using an approximation to the expression for the radiative cross-section which takes into account its variation with energy. From the results the "track length" of electrons (neglecting pair production and Compton effect) is evaluated for some special cases and compared with the numerical calculations of Richards and Nordheim. The agreement appears to be good. [See Abstr. 6253 (1949)]. A.

537.534 : 621.384.6

3196. Operation of the 184-in. cyclotron. L. R. HENRICH, D. C. SEWELL AND J. VALE. *Rev. Sci. Instrum.*, **20**, 887–98 (*Dec.*, 1949).

The operation of the 184 in synchro-cyclotron is reviewed in terms of the theory as developed by Bohm and Foldy. Certain relevant data on the properties of the magnet and rotating condenser are also presented. A.

537.534

3197. Ion optics and mass spectrometry. WALCHER. *Nucleonics*, **5**, 42–51 (*Oct.*, 1949).

The optical constants of magnetic and elect sector fields are derived by a simple method. T magnetic case is developed in some detail for sect of any central angle; by drawing the normal trajecto as a straight optical axis, the system becomes analog to a thick optical lens, with the usual familiar pressions. A variation of particle momentum equivalent to a parallel displacement of the ax Expressions for mass dispersion and resolving pov are given. The combination of electric and magne sectors to compensate for inhomogeneity in parti energy is demonstrated. The effects of bounda spreading of magnetic fields and space-charge repulsi in intense beams are discussed, also 2nd-orc aberrations in magnetic sectors. L. R. SHEPHE

537.534.

3198. Neutron–proton and proton–proton cr section at 83 MeV. L. CASTILLEJO AND H. RICHARDSON. Letter in *Phys. Rev.*, **76**, 1732 (*Dec.* 1, 1949).

Calculations.

537.534.75 : 778

3199. Stopping power of nuclear emulsions ionizing particles. H. G. DE CARVALHO. Letter *Phys. Rev.*, **76**, 1729–30 (*Dec.* 1, 1949).

An empirical relation is given which holds with a wide range of velocities. The relation is $S = R_0/R = A\beta^k$, where S = stopping power, R the length of t track in the medium concerned, R_0 in dry air at 15 and 760 mm Hg, A and k being constants whi depend only on the nature of the medium and $\beta = v/$ Deviations from experimental data are attributed moisture content of the emulsion. The stoppi power values for electrons within the range of from 0·3–0·8 calculated on the basis of the chemic composition of C_2 and $NT4$ emulsions show discrepancy up to 8% if compared with the data c electron ranges by Ross and Zajac. R. H. HER

DISCHARGE TUBES . COUNTERS 537.54

537.542 : 539.16.0

3200. Ionisation chambers and counters—exper mental techniques. B. B. ROSSI AND H. H. STAU (*National Nuclear Energy Series Manhattan Proje Technical Section Division V—Volume* 2) *New Yor Toronto, London, McGraw-Hill Book Co. Inc.* (194 243 *pp.*

Four chapters deal with fundamental principles c ionization chambers, the remaining 5 are devoted t details of design and operation of typical chambe and counters.

I. Behaviour of Free Electrons and Ions in Gase The diffusion of ions and electrons in a gas is di cussed and expressions derived relating drift velocit w and mean agitation energy ε to the applied electri field E, gas pressure p and other relevant parameter Curves of w and ε as a function of E/p are give for H, N, Ne, He, A, CO_2, BF_3 and A + CO_2 mixture

ta is also given for electron attachment probabilities H_2O and O, and the mobilities and diffusion coeffs. positive ions in H, He, A, N, O, CO_2 air and ane.

II. Operation of Ionization Chambers with Con- nt Ionization (Integrating chambers). Ionization rrents are calculated for the case when diffusion d recombination are negligible and when these are ken into account. The effect of diffusion on the uration current is shown to be appreciable for plied potentials up to a few 100 V for electrons, t is much smaller for ions. Recombination has gligible effect when the carriers are electrons, but appreciable when these are negative ions.

III. Operation of Ionization Chambers with riable Ionization. Instantaneous currents and arges induced on the electrodes are derived when an instantaneous burst of ionization is produced, . by an α-particle, (*b*) a steady ionization is started discontinued abruptly. The charge induced on collecting electrode is shown to depend on the tial distribution of ionization when the time nstant of the chamber and external circuit is $\ll$ ne of positive ion collection ($\sim$ 1 msec) and $\gg$ time electron collection (electron-pulse chamber), but en this time constant is $\gg$ positive ion collection e the charge depends only on the amount of ization. The value of a grid in electron-pulse ambers is mentioned. Expressions are derived for nsient responses (pulse shapes) from ion chambers d attendant amplifiers. Edge effects and effects of fusion on pulse heights are discussed briefly. perimental methods for studying transient responses outlined. Statistical fluctuations of current in egrating chambers are treated in an elementary nner.

IV. Gas Multiplication. The operation of cylin- cal chambers with axial wire collectors at suffi- ntly high voltage to produce gas multiplication is nsidered. Attention is confined to sub-critical ltiplication (proportional counters), G.M. counters not discussed. A number of experimental curves gas multiplication as a function of applied potential counters of specified dimensions is reproduced, fillings include H, CH_4, A, N, BF_3 and various xtures at specified pressures. Spread in pulse ight resulting from electron attachment, end effects d eccentricity of the collector wire is discussed efly. An A + CO_2 filled, proportional counter, ving several parallel wire collectors formed into a ne grid supported between two parallel electrodes described in detail.

V. Beta-Ray, Gamma-Ray and X-Ray Detectors ctron detectors). The operation of a G.M. type ounter is described, a semi-empirical expression the efficiency in terms of absorption coeffs. and ondary electron ranges is quoted and calculated ves given showing efficiency versus γ-ray energy Cu and Bi counters. Detailed designs are set out γ- and X-ray integrating chambers, β- and γ-G.M. nters and a pulsed breakdown γ-ray counter.

VI. Alpha Particle Detectors. Includes an account the use of ion chambers containing thin α-sources measuring α-particle energy spectra by pulse lysis. 2π and 4π solid angle chambers and proportional counters, for absolute measurement of α-source strengths are described, also special arrangements for α-particle range measurements.

VII. Detectors for Neutron Recoils. A short treatment is given, dealing with the distribution in energy of recoiling nuclei resulting from collisions by fast monokinetic neutrons. Pulse height distributions due to recoiling protons from thin and thick hydrogeneous radiators in electron and ion-pulse chambers and proportional counters are studied. Gas recoil chambers, in which H forms part or whole of the filling, are treated in a similar way. A number of ionization chambers for fast neutron flux and energy measurements is described in detail. These include a high pressure (up to 26 atmos.) H or H + A filled, parallel plate ion-pulse chamber of high counting efficiency; a high pressure A filled, gridded parallel plate electron pulse chamber employing a thin radiator, with permanently connected Ca purifier; a double parallel plate chamber with common high voltage electrode coated on one side with a thin glycerol tristearate radiator and on the other side with a thin fissile layer (for accurate measurement of fast fission cross-sections); gas recoil and thin radiator proportional counters; a "homogeneous" integrating gas-recoil chamber with C_2H_4 filling and walls coated internally with paraffin wax.

VIII. Detectors of (n, α) and (n, p) Reactions (for neutron flux and energy measurements). Attention is confined to the $B^{10}(n, \alpha)$ Li^7 reaction and several chambers and proportional counters with BF_3 filling or thin B radiators are described, including flat response counters (BF_3 counters embedded in paraffin wax, having fairly constant efficiency for a wide range of neutron energies) and chambers with accurately known active volumes for absolute flux measurements.

IX. Fission Detectors (Chambers containing thin layers of fissile material for measuring fission cross-sections, neutron fluxes and fission fragment spectra). The problem of detecting fission pulses against a large background of smaller α pulses is considered and the need for using fast detecting systems is stressed. Detailed descriptions are given of chambers using fissile layers much thinner than the fragment ranges, which show flat bias curve plateaus and are useful for absolute measurements and chambers with thick layers of large area for relative flux measurements with high counting efficiency. The construction of spirally wound chambers with U_3O_8-coated electrodes, concentrating large amounts of U into small compact volumes, is described at length.

Appendix includes range-energy curves for α-particles, deuterons and protons in air, A, Xe, paraffin and glycerol tristearate; energy required to produce one ion pair by electrons, protons and α-particles of specified energy in various gases; σ_s of neutrons for H and D as a function of energy and other data useful in the design of the chambers and counters described in the text. L. R. SHEPHERD

537.542

3201. Self-extinguishing Geiger–Müller counters of low efficiency. M. I. Daion. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 3) 305–8 (1949) *In Russian.*

537.542

3202. Deadtime and recovery of Geiger counters. *Atomics*, **1**, 56–7 (*Sept.*, 1949).

Gives a brief elementary account of Geiger counter action, the significance of the dead time and recovery time and concludes by describing in outline an electronic gating circuit developed at the N.B.S. for the study of dead times, etc. J. D. CRAGGS

537.542

3203. On the functioning of external-cathode counters. P. BASSI AND E. BERETTA. *Nuovo Cim.*, **6**, 585–90 (*Nov.* 17, 1949) *In Italian.*

In these counters the cathode is a metallic layer deposed on the external surface of the glass; the discharge occurs through the glass, which presents a resistance of the order of $10^8\,\Omega$, and a capacitance of 1 000 $\mu\mu$F. The system is then equivalent to a normal counter in series with a parallel RC circuit. A systematic study was made of this device, which, when filled with a mixture of A and alcohol, presents a longer plateau and a slower successive rise than ordinary counters; it is also impossible to obtain a continuous discharge. The secondary emission from the glass was also studied directly. All experimental results may be explained by considering the behaviour of the internal potential. L. PINCHERLE

537.542

3204. The gamma-ray counting efficiency for a lead-cathode G–M counter. E. T. JURNEY AND F. MAIENSCHEIN. *Rev. Sci. Instrum.*, **20**, 932–4 (*Dec.*, 1949).

The dependence of γ-ray counting efficiency on energy has been determined in the range 0·17 MeV to 2·76 MeV for a G–M counter with a Pb cathode. The efficiency for 6 energy values was found by coincidence measurements utilizing the disintegration of In^{111}, Au^{198}, Co^{60} and Na^{24}. The result indicates a smooth increase in counting efficiency for increasing energy over the range of energies investigated. A.

537.542

3205. Long-lived self-quenching counter filling. L. G. SHORE. Letter in *Rev. Sci. Instrum.*, **20**, 956–7 (*Dec.*, 1949).

537.542

3206. A review of Geiger–Müller counters. *Atomics*, **1**, 37–44, 48 (*Feb.*, 1950).

537.542 : 621.383.27

3207. A secondary-emission electron multiplier tube for the detection of high energy particles. R. P. STONE. *Rev. Sci. Instrum.*, **20**, 935–41 (*Dec.*, 1949).

The requirements of high gain and low background current in an electron-multiplier tube for the direct detection of high energy particles are considered. The design and construction of an experimental electron-multiplier tube with a stable over-all gain of at least 10^8 and a background at room temperature corresponding to 3 or 4 electrons per minute released at the input is described. A 0·0008 in thick Ni window is provided in the tube envelope to admit the high energy particles to the multiplier. The efficiency of this device is compared quantitatively with that of a Geiger tube as a detector of β-particles. It is found that the over-all β-particle counting efficiency of the tube is of the order of 1·3%, and that the efficiency of the oxidized Ag–Mg target surface is 4·9% for a U source and 6·0% for a Sr source.

537.5

3208. An air ionization chamber for soft X-ray H. E. SEEMANN. *Rev. Sci. Instrum.*, **20**, 903 (*Dec.*, 1949).

An ionization chamber is described which is near air-equivalent from 0·5 to 2·5 Å, "effective wav length." It has been made adaptable for use wi the electrometer and charging system of the Victoree Minometer. Its sensitivity is of the order of 0· roentgen per scale division. Suggestions are ma for possible improvements.

537.5

3209. On the new technique of scintillation counter M. AGENO, M. CHIOZZOTTO AND R. QUERZOL *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Na* **6**, 453–7 (*April*, 1949) *In Italian.*

A preliminary paper dealing with the properties a photomultiplier (*R.C.A.* 931 A). A criterion given for the measure of sensitivity s for very sma luminous intensities. s was found to vary wide between different tubes and to increase to a saturati value with the increase of the applied potenti s also increases at low temps., as noise due thermionic emission is then reduced. L. PINCHER

537.5

3210. The dependence of the brightness of th scintillations of zinc sulphide on the dimensions of th crystal. T. V. TIMOFEEVA. *Dokl. Akad. Nau SSSR*, **66** (*No.* 6) 1079–80 (1949) *In Russian.*

537.5

3211. Temperature dependence of scintillation puls in anthracene. G. G. KELLEY AND M. GOODRIC Letter in *Phys. Rev.*, **77**, 138 (*Jan.* 1, 1950).

537.5

3212. Automatic stabilization of the overvoltage a Geiger counter. H. R. CRANE. Note in *Rev. Sc Instrum.*, **20**, 955–6 (*Dec.*, 1949).

537.5

3213. A stabilizer for proportional counters. D. H WILKINSON. *J. Sci. Instrum.*, **27**, 36–8 (*Feb.*, 1950).

It is pointed out that proportional counters conventionally used are not precision instrumen over long periods. The introduction of an α-partic group into the counter enables high precision to b attained by deriving control of the voltage applied the counter from this group. It is shown to be possib to derive such control, compensating for leaks, ou gassing or changes in electronic amplification, an yet inappreciably interfere with the intrinsic varianc imposed on an initially sharp group by straggling the ionization yield and the statistical nature of th gas amplification process. A suitable circuit is brief described.

537.542 : 621.318.57

3214. A high resolution scale-of-four. V. FITC *Rev. Sci. Instrum.*, **20**, 942–4 (*Dec.*, 1949).

A high resolution scale-of-4 has been developed t be used in conjunction with the nuclear partic detection devices in applications where the countin rate is unusually high. Specifically, it is intended t precede the commercially available medium-resolutio

aling circuits and so decrease the resolving time of e counting system. The circuit will function liably on continuously recurring pulses separated $< 0{\cdot}1$ μsec. It will resolve 2 pulses (occurring at moderate repetition rate) which are spaced at 04 μsec. A 5 V input signal is sufficient to actuate e device. A.

537.542 : 621.318.572

215. Scaler units for counting pulses from Geiger–Mueller counters or ionization chambers. S. JNANANNDA. *J. Sci. Industr. Res.*, **8**, 471–82 (*Dec.*, 1949). Review.

537.542

216. Statistics of counting rate meters. R. E. URGESS. Note in *Rev. Sci. Instrum.*, **20**, 964–5 *Dec.*, 1949).

537.542 : 621.392.54

217. Pulse-height limiting circuit for a scintillation etector. W. C. ELMORE. Note in *Rev. Sci. Instrum.*, **0**, 963–4 (*Dec.*, 1949).

537.542 : 621.396.615.17 : 621.318.572

218. Circuit for rapid determination of resolving ower and other characteristics of coincidence-systems. I. DE WAARD. *Rev. Sci. Instrum.*, **20**, 911–15 (*Dec.*, 949).

A simple device is described in which pairs of pulses re produced that are moved continuously with espect to each other (wobbled) by an a.c. voltage hat also sweeps an oscilloscope spot horizontally. he pulses are applied to both inputs of a coincidence ystem. Vertical deflection of the c.r.o. spot is aused by the output pulses of the system. Thus arious characteristics can be made visible and the esolution can be read from the screen at a glance. With the instrument resolving powers from 3×10^{-6}–$.0^{-9}$ sec approx. can be determined. The apparatus vas calibrated by feeding the wobbling pulses into a adio receiver. The output of the receiver has a sharp minimum when the pulse distance (Δt) satisfies the ondition $\Delta t = (1 + 2n)/2\nu$ where n is an integer, ν is the frequency to which the receiver is tuned. A.

IONIZATION . THERMIONICS 537.56/.58

537.568

219. A note on temperature and the recombination oefficient. N. C. GERSON. Letter in *J. Chem. Phys.*, **7**, 1351–2 (*Dec.*, 1949).

537.583 : 621.385.032.216

220. Reversibility of oxygen poisoning in oxide-athode valves. G. H. METSON. Letter in *Nature*, *Lond.*, **164**, 540–1 (*Sept.* 24, 1949).

O_2 poisoning was studied in diodes whose anode otential was below the ionization potential of the as remnants and below the dissociation potential of BaO. It was found that recovery after poisoning vas complete for at least 3 cycles of poisoning and eactivation. The rate of reactivation increased with urrent density but was independent of temp. and is herefore considered to be not an electrolytic effect, ut a field effect. Measurements of reverse grid current in a triode show that the gas pressure increases during reactivation to a constant value.

A. H. W. BECK (R)

537.583 : 621.385.1.032.216

3221. Thermionic emitting properties of thoria–rhenium. G. A. ESPERSEN. Letter in *J. Appl. Phys.*, **21**, 261 (*March*, 1950).

Emitters consisting of 50% thoria–50% rhenium were fabricated into rods by extrusion, after which they were fired successively at 1 500°C for 15 minutes in wet H_2 and 2 000°C for 15 minutes in dry H_2. The emitter rods were assembled into guard-ring type diodes using Mo anodes. Thermionic emission data indicated average values of $A = 11{\cdot}7$ A/cm²/deg. K, $\phi = 2{\cdot}83$ eV for the Richardson equation. A.

COSMIC RAYS 537.591

537.591

3222. A proportional hodoscope. L. N. KORABLEV. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 5) 643–6 (1949) *In Russian.*

A 3-electrode cold-cathode gas discharge tube is used as a coincidence valve. Coincidental pulses on grid and cathode strike the discharge, which is then recorded photographically. The pulses from a proportional counter are fed to the grids of 5 of these valves, the cathodes of which are supplied with master pulses of 5 different amplitudes. In this way a 5-channel pulse-size distribution record is simply obtained. The theory of the gas-discharge is discussed. E. P. GEORGE

537.591

3223. Report on Como conference on cosmic radiation. M. SCHEIN. Note in *Science*, **111**, 16–19 (*Jan.* 6, 1950).

The scope and programme of the conference are described, and short summaries of 25 contributed papers given. J. G. WILSON

537.591.1

3224. The heavy nuclei of the primary cosmic radiation. H. L. BRADT AND B. PETERS. *Phys. Rev.*, **77**, 54–70 (*Jan.* 1, 1950).

The flux of primary cosmic-ray nuclei, heavier than protons, was determined at geomagnetic latitudes $\lambda = 55°$ and $\lambda = 30°$N. It is shown that at $\lambda = 30°$ at least ½ of the incident nucleons and a significant fraction of the incident cosmic-ray energy is due to the heavy component. The distribution of atomic numbers among the primaries was determined at both latitudes; the relative magnitude of the fluxes of the nuclei H : He : C,N,O : (nuclei of charge $Z > 10$) is given approximately by the ratio 4 000 : 1 000 : 35 : 10. The possible significance of these results for the theories on the origin of cosmic rays is discussed. A.

537.591.1

3225. The spectrum of the heavy nuclei of the primary cosmic radiation at 22 km. T.-F. HOANG. *C.R. Acad. Sci., Paris*, **230**, 292–4 (*Jan.* 16, 1950) *In French.*

123 tracks of heavy nuclei observed in Ilford *G5*

photographic plates are analysed. The relative abundances are shown to be similar to those given by A. Unsöld [*Zeits. f. Astrophys.*, **21**, 1 (1941)] for Scorpio-τ. The energies of the heavy nuclei on entering the atmosphere are all $>$ the magnetic cut-off energy, but $<$ those expected from Fermi's theory of the origin of cosmic rays. E. P. GEORGE

537.591.15

3226. Report on recent work on penetrating showers and penetrating particles. I. K. Sitte. *Acta Phys. Austriaca*, **3** (*Nos* 2–3) 198–228 (1949) *In German.*

This part, dated July 1948, reviews experimental work on penetrating showers, with the main emphasis on the Manchester school (Janossy, Rochester and co-workers), up to that time. J. G. WILSON

537.591.15

3227. On the generation of a high-energy electron-photon component. G. Ya. Artyukhov, G. T. Satsepin, L. I. Sarycheva and L. Kh. Eĭdus. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 2) 153–6 (1949) *In Russian.*

The narrow structure of showers observed when high-energy electrons and photons are emitted is explained by the formation of special showers in the atmosphere: the occurrence of photon showers suggests that photons are present in special showers which become converted into electrons during the passage through the atmosphere. Electrons of energy $2\text{–}3\times10^9$ eV were observed. A close connection is established between the electron-photon component and penetrating and nuclear active particles; this agrees with the view that nuclear active particles, which are responsible for the formation of this component at great depth of the atmosphere, are secondary particles. J. JACOBS

537.591.15

3228. An investigation of the connection between heavy particles and "special" showers in cosmic rays. A. N. Gorbunov and I. V. Chuvilo. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 3) 333–5 (1949) *In Russian.*

Coincidences were studied between 2 proportional counters, under thick Pb screens, at an altitude of 3 860 m. The particle density was determined by the coincidences produced in a further 3 fast counters in the same cavity. The conclusion is reached that about 75% of the 2-fold coincidences in the proportional counters are caused by nuclear fragments and the remainder by dense ("special") showers.

E. P. GEORGE

537.591.15

3229. A study of the dependence on height of showers created in the atmosphere by the primary cosmic radiation. S. N. Vernov and T. N. Charakhchyan. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 5) 629–30 (1949) *In Russian.*

Showers, produced in Pb by charged particles, were recorded by means of a 3-fold counter system, at heights in the atmosphere up to 28 km. The results, corrected for knock-on showers in Pb, show an exponential absorption of the particles generating the showers with $L_A \sim 100$ g/cm^2. Above 20 km the showers increase more rapidly, L_A being $\sim$ 50 g/cm^2. E. P. GEORGE

537.591.1

3230. Nucleo-active particles in wide atmospher showers. G. T. Zatsepin and L. E. Sarychev *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 5) 635–8 (1949) *Russian.*

6 banks of 12 counters each were arranged on above the other, with intervening Pb screens, t record penetrating showers. Further counter tray indicated atmospheric showers. The 72 counters the first set were connected to a hodoscope. Knock on showers produced by single particles were studied the frequency being 3·5%. The multiple discharge in the screened counters due to air showers wer much greater, $\sim$ 42% with $>$ 2 counters discharge in a certain bank, and are thus not explained b knock-on processes, nor can they be attributed t the arrival of independent μ mesons known to exis in atmospheric showers. The generation in Pb c dense groups of particles by "nucleo-active" particle is postulated. Nucleo-active particles must form 0·1 to 1·0% of the number of particles in air showers

E. P. GEORG

537.591.1

3231. Showers produced by mesons. P. Bassi an A. Loria. *Nuovo Cim.*, **6**, 559–64 (*Nov.*, 1949) *Italian.*

The authors have determined the percentage o mesons which generate electron showers in crossing various thicknesses of Pb and Fe. The number o showers produced by incoming cosmic-ray electron has been determined experimentally. Equilibrium i reached at 40 g cm^{-2} thickness for Pb and at 90 g cm^{-2} for Fe. J. CAMERIN

537.591.1

3232. Atmospheric and astrophysical factors ano large Auger showers. A. Daudin and J. Daudin *J. Phys. Radium*, **10**, 394–401 (*Dec.*, 1949) *In French*

Extended measurements of extensive shower intensity at Bagnères (550 m alt.) and Pic du Midi (2 860 m alt.) with arrays covering 5 m and 75 m (Pic du Midi only) are considered. There is no measurable difference of barometric coeff. with altitude nor between 5 m and 75 m separation. The temp. coeff., assumed to be a pure density effect, is deduced but not measured. A diurnal effect is also examined and the possibility of instrumental origin excluded; an astrophysical source is thus probable.

J. G. WILSON

537.591.1

3233. Local production of mesons at 11 300 feet. O. Piccioni. *Phys. Rev.*, **77**, 1–5 (*Jan.* 1, 1950).

Mesons produced in association with local penetrating showers have been investigated at 11 300 ft above sea level. The apparatus recorded delayed coincidences arising from the 2·2 μsec decay process of μ-mesons and distinguished the delayed coincidences which were associated with a local penetrating shower from those which were not. It is found that the fraction of penetrating showers which gives a delayed coincidence is in accordance with the assumption that the local penetrating showers are the typical events in which mesons are produced. The comparison of the delayed coincidence rate using C as the materia stopping the mesons, with the rate using S shows tha

locally produced particles are π-mesons. Since recent latitude experiment on local penetrating owers indicates that the average energy of the rticles producing such events is > 10 BeV, the ult of the present work extends to that energy the nclusion originated from observations in photo- phic emulsion, that only π-mesons, and not μ's directly created in the collision of fast particles. A.

537.591.15

34. On the secondary particles of local penetrating owers. O. PICCIONI. *Phys. Rev.*, **77**, 6–10 (*Jan.* 1, 50).

An analysis of the secondary particles of the local netrating showers has been done by means of sorption experiments and delayed coincidence asurements. The large majority of those particles, ered with about 12 in of Pb, appear to be mesons, ich have been identified as π-mesons in the ceding Abstr. The average number of those sons per shower is $\simeq 4$. The analysis appears to e a lower limit of 1 200 g/cm^2 for the mean free th for nuclear absorption of π-mesons having ergies of some 100 MeV. This result is discussed connection with other experiments on local netrating showers. A.

537.591.15

35. Nuclear transmutations produced by cosmic-y particles of great energy. III. Nature of the ower particles. P. H. FOWLER. *Phil. Mag.*, **41**, 9–84 (*Feb.*, 1950).

A new method of measuring the scattering of arged particles in their passage through photo- aphic emulsions has been developed. It has been ployed to determine the mass of charged particles erging from nuclear "explosions" produced by smic radiation. Of the mesons among the hower" particles, produced in these explosions th momentum $<$ about 180 MeV/c, it is shown at at least 90% are π-particles; and that $< 5\%$, and ssibly none, are μ-particles, electrons or other rticles of small mass. If mesons of greater mass e sometimes created in nuclear interactions with an ergy < 300 MeV, they must be produced with a quency $< 1\%$ of the protons and $< 5\%$ of the particles. The observations therefore prove that e great majority of the charged particles created in clear interactions are π-particles. The greatly creased rate of measurement with the new method d the fact that it allows the determination of the attering of particles of much greater energy than s been possible hitherto will enable a detailed study the nuclear transmutations produced by protons d α-particles with energies in the interval from 10^9 10^{10} eV to be made. A.

537.591.15

36. Some properties of penetrating cosmic-ray owers and star phenomena seen in the cloud chamber. C. BUTLER, W. G. V. ROSSER AND K. H. BARKER. *oc. Phys. Soc., Lond. A*, **63**, 145–64 (*Feb.*, 1950).

Cloud-chamber photographs of cosmic-ray showers ntaining penetrating particles have been obtained sea level. The spectrum of the penetrating particles s been measured and a study made of the interaction the energetic particles in Pb and in the gas of the cloud chamber. Conclusions about the nature of the penetrating particles are discussed; these show that about $\frac{1}{2}$ the penetrating particles are protons and the remainder are probably π-mesons and mesons of heavier mass. 3 heavy particles produced in stars are probably τ-mesons. A.

537.591.15

3237. Experiments on the nature of penetrating events in extensive air showers. B. CHOWDHURI. *Proc. Phys. Soc., Lond. A*, **63**, 165–72 (*Feb.*, 1950).

The discharges, in coincidence with extensive showers, of individual counters of a group placed in a cavity under 15 cm Pb have been studied with particular reference to the number of these counters simultaneously discharged in a single event. It is shown that the observed multiplicity of discharge is not consistent with operation by particles, each discharging one counter only, distributed at random in the extensive shower falling on the apparatus. The multiplicity is also inconsistent with that expected for low energy photons at the extreme range of normal cascades, and with that arising from the secondary electrons of a reasonable μ-meson spectrum. Entry of energy into the shielded cavity is shown to take place over an area $\ll$ the total area of the cavity, but the mechanism then leading to the observed multiplicity has not been identified. A.

537.591.3

3238. A study of the absorption of primary cosmic rays in the stratosphere. K. I. ALEKSEEVA AND S. N. VERNOV. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 3) 317–19 (1949) *In Russian.*

An extension of previous work [Abstr. 2542 (1950)]. The Pb absorber in the telescope of 3 counters has been increased to 8 cm Pb, and the side-screens of counters recording showers extended. Results are given for the frequencies of penetrating particles and of showers for various heights up to 25 km. Up to ~ 20 km (100 g/cm^2) the absorption length, L_A, of the particles generating showers in 8 cm Pb is found to be 120 g/cm^2, but above this height there is an abrupt change to 60 g/cm^2. At great height, the probability of shower production by the penetrating particles is very high, ~ 70 to 80%. The results are discussed, and it is concluded that the primary cosmic rays cannot be electrons.

E. P. GEORGE

537.591.3

3239. Cosmic rays at great depth. Y. MIYAZAKI. Letter in *Phys. Rev.*, **76**, 1733–4 (*Dec.* 1, 1949).

Earlier experiments at 1 400 m water equivalent [*Phys. Rev.*, **59**, 401 (1941)] have been extended to 3 000 m water equivalent. Showers are shown to be about $\frac{1}{4}$ of single counts, the ratio not changing significantly between 1 400 m.w.e. and 3 000 m.w.e. The single rays are strongly absorbed in Pb (20% remain after 1 m Pb); it is therefore concluded that $< \frac{1}{5}$ of single particles can be charged primaries.

J. G. WILSON

537.591.3

3240. Interpretation of underground cosmic-ray data. K. GREISEN. Letter in *Phys. Rev.*, **76**, 1718–19 (*Dec.* 1, 1949).

Underground vertical cosmic-ray intensity follows

a $\sim 1{\cdot}9$ power law to 300 m.w.e. depth and thereafter a $\sim 2{\cdot}9$ power law. Extensive air showers follow energy spectrum $\sim 1{\cdot}8$ to much higher energies. It is shown that the explanations of the underground anomaly by Barnothy and Forro (neutral decay products of mesons penetrate and produce detectable secondaries) and by Greisen and Hayakawa (μ-mesons penetrate, but undecayed π-mesons reaching solid earth are absorbed in a nuclear process of cross-section $> 0{\cdot}001$ times geometrical cross-section of nucleus), are formally equivalent as regards depth variation and zenith angle variation, although the arbitrary cut-off of the μ-meson spectrum implicit in the theory of Barnothy and Forro is noted. The nature of the particles underground is in principle determined by absorption measurements, but the precision of existing results is low. The large absorption reported by Miyazaki (preceding Abstr.) at 3 000 m.w.e. is not consistent with the view that most charged particles observed are identical with those which have penetrated from the surface of the earth.

J. G. WILSON

537.591.5

3241. Cosmic rays in the atmosphere. S. Hayakawa and J. Nishimura. *J. Sci. Res. Inst., Tokyo*, **44**, 47–58 (*Nov.*, 1949).

The description of the nucleonic and mesonic components of cosmic rays in the atmosphere is attempted in terms of a primary spectrum based on geophysical data and on energy flux, on the atmospheric absorption length for nucleons, and on a postulated form of meson production. The altitude variation, sea-level spectrum and latitude effect, at sea level and at 300 g.cm^{-2} pressure, are calculated and compared with experimental data. The possible effect of a significant α-component in the primary flux is noted.

J. G. WILSON

537.591.5

3242. Directional properties and latitude variation of nucleon-induced cosmic ray phenomena in sensitive emulsions. C. Beets, M. Morand and L. Winand. *C.R. Acad. Sci., Paris*, **229**, 1227–8 (*Dec.* 5, 1949) *In French.*

G3 and *C3* + *B* plates have been exposed at 4 500 m altitude in geomag. lat. 1° *S*. Isolated tracks show an average *E–W* asymmetry of 0·11, the less heavily ionizing particles from large stars (> 9 branches) are predominantly in the downwards direction, and the total number of stars (> 2 branches) is less by a factor 2·4 than that deduced for 44° *N* geomag. lat. from measurements in that latitude at 3 470 m altitude.

J. G. WILSON

537.591.5

3243. Directional measurements of the diurnal variation of cosmic-ray intensity. H. Elliot and D. W. N. Dolbear. *Proc. Phys. Soc., Lond. A*, **63**, 137–44 (*Feb.*, 1950).

Measurements of the solar daily variation in intensity have been made for a total of 360 days using 2 arrays of counters inclined at 45° to the vertical in the *N* and *S* directions. Both the diurnal and semi-diurnal variations are found to be significantly different for the 2 directions, and since the particles recorded by the 2 sets have passed through the same amount of atmosphere under similar cc ditions, it must be supposed that at least a part of t variation is due to causes which lie outside the eart atmosphere. It is found that both the amplitude a phase of the daily variation for the *S*-pointing recor vary with season, whereas in the *N* direction t amplitude only shows any seasonal variation. T amplitude is greatest in summer in both directio The experimental results are compared with those earlier workers and are discussed in relation to so of the interpretations of the daily variation which ha been put forward. The difference between the var tions in the 2 directions is interpreted as evide for a non-isotropic distribution of the primary cosm rays in space. A variation with sidereal and not w solar time would be expected under these conditio but it is pointed out that the magnetic field of the s may modify the direction of arrival of the prima rays at the earth so as to produce a resultant so time variation.

537.591.5 : 52

3244. On the low energy spectrum of prima cosmic radiation and the sun's magnetic dipole mome M. A. Pomerantz and M. S. Vallarta. Letter *Phys. Rev.*, **76**, 1889–90 (*Dec.* 15, 1949).

Balloon flights at 52° *N* and 69° *N* geomagne measuring the vertical cosmic-ray intensity with a without 7·5 cm Pb absorber, yield intensity ratios these latitudes at the top of the atmosphere. W no Pb, $I(69°)/I(52°) \sim 1{\cdot}46$. The differential prima spectrum between 0·1 and 1·6 BeV is deduced. T measurements are shown to be inconsistent with t calculated diurnal variation of vertical intensity a solar dipole moment $> 0{\cdot}6 \times 10^{33}$ gauss-cm^3. T possibility of large variations of solar field is therefo envisaged.

J. G. WILS

537.59

3245. The production of heavy particles, and t absorption of their generating components in materi at 3 860 meters. G. E. Belovitskiĭ and L. V. Sukho *Dokl. Akad. Nauk, SSSR*, **62** (*No.* 6) 757–9 (194 *In Russian.*

Nuclear emulsion photographic plates were expos under various absorbers: Pb up to 28 cm, 5·6 cm S and 20 cm Al. The frequency of single heavy trac is reported. No increase at ~ 2 cm was foun The ranges of the particles producing the tracks a reported to be: Air ~ 160 g/cm^2, Al ~ 500 g/cm Pb ~ 560 g/cm^2. From the difference between and Al, it is concluded that the generating partic are unstable.

E. P. GEOR

537.59

3246. Experimental investigation of cosmic rays the photo-plate method at various altitudes. A. Zhdanov and Yu. N. Podkopaev. *Dokl. Ak Nauk, SSSR*, **64** (*No.* 3) 313–16 (1949) *In Russian.*

537.59

3247. The instability of cosmic ray particles caus nuclear disintegrations. G. E. Belovitskiĭ, N. Maslennekova, V. F. Smirnov and L. V. Sukho *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 3) 321–4 (19 *In Russian.*

Nuclear emulsions sensitive to 100 MeV prot were exposed at 3 860 m for 27 d, and the freque

stars compared with that in similar plates exposed 4 700 m which were covered with C equivalent to e difference in air pressures. The frequency of 2- d 3-prong stars was lower in the first plates. That the larger stars remained the same. It is concluded at the particles causing 2- and 3-prong stars are istable, with $\tau = 5\times10^{-6}$ to 10^{-5} sec. E. P. GEORGE

537.591.8

248. Solar flares and the origin of cosmic radiation. III. J. CLAY, H. F. JONGEN AND A. J. DIJKER. *Proc. K. Ned. Acad. Wet.*, **52** (*No.* 9) 923–6 (1949).

Comparison of Ehmert's measures [Abstr. 419 (1949)] with Amsterdam records [see Abstr. 670 (1950)] shows that with increases of cosmic-ray intensity associated with solar flares, the percentage increase as well as the time of maximum depends upon the particle energy. M. W. OVENDEN

537.591.8

249. Multiple meson and γ-ray production in cosmic ray stars. H. L. BRADT, M. F. KAPLON AND B. PETERS. *Helv. Phys. Acta*, **23** (*Nos* 1–2) 24–63 (1950).

A shower of some 56 singly charged, relativistic particles, produced by a primary α-particle of energy 10^{12}–10^{13} eV, which has been observed in a stack of photographic plates exposed to the cosmic radiation at an altitude of 30 km, is analysed in detail. This shower presents evidence for the generation of both high energy mesons and γ-rays with large multiplicity. Almost ½ of the mesons of this shower are concentrated in a narrow core of half-width 1·5°; the others are spread out over an angular interval of ± 60°. Multiplication of charged particles (production of pairs) in the shower core indicates the presence of a large number of high energy γ-ray quanta. The energy of the γ-rays is estimated from the angle of divergence of the observed pairs. Assuming that the γ-rays result from the decay of neutral mesons, the lifetime of these mesons is estimated to be $\lesssim 10^{-13}$ sec. The structure of the shower can be explained either by the assumption of multiple meson production in primary, secondary and tertiary encounters in the target nucleus (plural production) and/or by the assumption of a considerable degree of anisotropy of the meson production in the centre-of-mass system of the incident and target nucleons in the primary encounter. These conclusions are based on the transformation relations connecting the angular distribution of the mesons in the laboratory system with the angular and the energy distribution of the mesons in the centre-of-mass system. Besides pair production by high energy γ-rays, a case of pair production by an energetic electron has been observed. A.

537.591.8

3250. Theoretical considerations on the generation and positive excess of the meson component of the cosmic radiation. P. CALDIROLA. *Nuovo Cim.*, **6**, 565–84 (*Nov.*, 1949) *In Italian.*

Assuming a power law for the energy spectrum of the primary cosmic-ray protons and plural meson production, the author has calculated the energy spectrum of the μ-mesons and their positive excess at various altitudes. Good agreement with experiment has been found. U. CAMERINI

537.591.8

3251. Disintegration electrons from Li_3^8 nuclei ejected in cosmic stars. E. PICKUP AND L. VOYVODIC. Letter in *Phys. Rev.*, **76**, 1534 (*Nov.* 15, 1949).

4 examples of "hammer tracks" emerging from cosmic-ray stars in *G5* emulsions exhibit the Li^8–Be^8 decay electron copunctual with the subsequent Be^8 decay. J. G. WILSON

537.591.8

3252. Evidence of multiple meson and γ-ray production in cosmic-ray stars. M. F. KAPLON, B. PETERS AND H. L. BRADT. Letter in *Phys. Rev.*, **76**, 1735–6 (*Dec.* 1, 1949).

A nuclear explosion initiated at 100 000 ft by a primary α-particle consists initially of (*a*) a narrow core of about 23 relativistic particles in an angular spread 2·5°; (*b*) a fan (angle ~ 70°) of about 30 further relativistic particles; and (*c*) 18 heavy tracks accounting for at least 23 units of charge. The narrow core is referred to meson formation in the primary collision and the diffuse core to further meson formation by projected nucleons. The angle of divergence of the narrow core, referred to centre of mass of a nucleon in the α-particle and a second in the target nucleus, leads to an estimate of primary energy, $E_\alpha \sim 0\cdot8\times10^{13}$ eV. The number of relativistic particles in the narrow core increases to about 44 in 0·26 radiation units of glass and emulsion, and examples of pair formation are observed. The total numbers of γ-quanta in the core is shown to be of the order of the number of charged mesons, and their average energy is not $\geqslant$ 10 BeV. The implications on the postulate of decay of neutral mesons is considered. J. G. WILSON

537.591.8

3253. Nuclear disintegrations as detected with electron-sensitive emulsions exposed in the stratosphere. J. J. LORD AND M. SCHEIN. *Phys. Rev.*, **77**, 19–25 (*Jan.* 1, 1950).

The nature of high energy nuclear interactions produced in photographic emulsions was investigated in the stratosphere. Examples are given, which were selected to show the principal modes of interactions, which lead to the emission of groups of particles with ionization energy losses corresponding to the minimum value for singly charged particles. For cases in which > 2 particles of minimum ionization were emitted, the incident particle was found to be charged in nearly every case. The angular distribution of emitted minimum ionization tracks was measured as a function of the angle with the direction of the incident track. The zenith angle distribution of incident particles producing groups of minimum ionization tracks is given for 2 different altitudes in the stratosphere. A.

537.591.8

3254. Nuclear explosions observed in lead with counters. A. CACHON, J. DAUDIN AND R. MAZE. *C.R. Acad. Sci., Paris*, **230**, 290–2 (*Jan.* 16, 1950) *In French.*

Observations of coincidences in various groups

of counters screened with Pb absorbers are used to determine the density of particles in penetrating showers. The integral density spectrum in the Pb is shown to be of the form $I(>x) = Bx^{-\gamma}$, with $\gamma \sim 2{\cdot}3$. E. P. GEORGE

537.591.8

3255. Emission of protons and alpha-particles in high energy cosmic ray stars. D. H. PERKINS. *Phil. Mag.*, **41**, 138–43 (*Feb.*, 1950).

Describes measurements of the energy, angular and frequency distributions of protons and α-particles in disintegrations of the Ag and Br nuclei of nuclear emulsions, at excitation energies ⩾ the binding energy (∼ 700 MeV). Only those charged particles with ionization > 6× min. have been considered (i.e. > that of a 50 MeV proton). The star disintegrations were observed in Ilford *C*2 plates, 100 μ thick, exposed at Jungfraujoch (3 457 m). A.

537.591.8 : 577.3

3256. Cosmic radiation and its biological effects. V. F. HESS AND J. EUGSTER. *New York, Fordham University Press, Declan X. McMullen Company Inc.* (1949) 173 *pp.*

This book is in two parts. The first, by Hess, gives a general account of cosmic radiation. The second part, by Eugster, gives an account of his investigations into the biological effects of cosmic radiation, performed more than 10 years ago. The biological material was divided into two groups, one group screened with 1·8 cm lead, and the other unscreened. Any difference in the subsequent properties of the two groups was attributed to the effects of the increased cascade showers incident on the screened groups. In this way, the inhibition of the growth of bacterial spores and antirrhinum seeds by cosmic-ray showers is alleged to be demonstrated. Further experiments are claimed to show a stimulation of reproduction in Drosophila and an inhibition in rabbits. 2½ pages are devoted to an experiment (unfinished in 1937) in which the stimulation of tumours by showers, in a strain of mice subject to spontaneous carcinoma, is reported. E. P. GEORGE

MAGNETISM 538

538.082.74

3257. Concerning the problem of the measurement of a magnetic field by a ballistic method. K. V. INOZEMTZEV AND G. D. LATYSHEV. *Izv. Akad. Nauk, Ser. Fiz.*, **13** (*No.* 4) 453–5 (1949) *In Russian.*

538.082.74

3258. The measurement of magnetic field strength by an inductive method. YU. YA. KONAKHOVICH, G. D. LATYSHEV AND V. V. TSIMBALIN. *Izv. Akad. Nauk, Ser. Fiz.*, **13** (*No.* 4) 456–64 (1949) *In Russian.*

538.083.9

3259. A sensitive magnetometer for very small areas. D. M. CHAPIN. *Rev. Sci. Instrum.*, **20**, 945–6 (*Dec.*, 1949).

A vibrating wire system for measuring weak magnetic fields is described for use in very small spaces. Quartz crystals are used for drivers to get sufficient velocity with very small displacements. To adjust the driving voltage to correspond exactly to the natural crystal frequency, the crystal is also used to regulate the oscillator. A.

538.114

3260. The influence of atomic order on magnetic properties. J. E. GOLDMAN. *J. Appl. Phys.*, **20**, 1131–6 (*Dec.*, 1949).

Reviews observed effects of order-disorder transformations on both structure-insensitive and structure-sensitive properties of ferromagnetic alloys. The theory, based on fluctuations in the local electron density at the various lattice points, which explains the increase of saturation moment on ordering of 50% Fe–Co [see Abstr. 2014 (1949)], is applied to Ni_3Mn and a Heusler alloy, and provides a satisfactory explanation of the observed changes in moment. The theory also indicates changes in anisotropy and magnetostriction, and these as well as internal stress variations are the cause of the large alterations in μ_0 and H_c produced by ordering. C. E. WEBB

538.223

3261. The magnetic susceptibility of the intermetallic compound Mg_2Sn. B. I. BOLTAKS. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 4) 487–90 (1949) *In Russian.*

538.222

3262. Magnetic susceptibility of formaldehyde solutions. R. SAUTEREY. *C.R. Acad. Sci., Paris*, **229**, 884–6 (*Nov.* 2, 1949) *In French.*

From measurements on solns. of formaldehyde at concs. of from 37·2 to 321·9 g/l the susceptibility has been derived as $-0{\cdot}50\times10^{-6}$. This value, which differs from the recorded value of Meslin, is ⩾ that anticipated from Pascal's atomic susceptibilities for $H_2C{=}O$ and differs also from values for polyoxymethylene glycols likely to be found in the solution. The author has already shown [*ibid.*, **221**, 595 (1945)] that at high *p*H formaldehyde solutions can be directly oxidized by I. The variation in χ with *p*H has been investigated and the possibility of the existence of a methylene glycol ion $H_2{=}C{-}O^-$ in solution is advanced.

OH

W. R. ANGUS

538.221

3263. Temperature-dependence of the coercive force in single crystals of transformer steel. YA. S. SHUR AND K. B. VLASOV. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 6) 1081–4 (1949) *In Russian.*

538.221

3264. Magnetic measurements on basalt. E. BRAUNSTEINER AND L. CASTELLIZ. *Acta Phys. Austriaca*, **3** (*Nos* 2–3) 184–97 (1949) *In German.*

The magnetic susceptibility of naturally occurring basalt, containing several oxide components besides Fe_2O_3, was measured for a range of temperatures (room temperature to 1 250°c) of a preceding heat treatment. The susceptibility-annealing temperature curve shows marked ferromagnetic maxima at certain temperatures, which are interpreted as magnetic transformation points, corresponding to the formation of ferrites from the oxide components.

E. P. WOHLFARTH

538.221 : 537.226.2

5. The properties of ferromagnetic compounds at timetre wavelengths. J. B. BIRKS. *Proc. Phys. ., Lond. B*, **63**, 65–74 (*Feb.*, 1950).

The magnetic and dielectric properties of γ-ferric de, magnetite, Mn–Zn ferrite and Ni–Zn ferrite e been measured at wavelengths from 60 cm to 23 cm. The pronounced magnetic dispersion and sorption which occur are attributed to the decay the rotational magnetization, due to Larmor spin onance in the internal anisotropy field H_N. The oretical relation $H_N = 2K/M$, where K is the isotropy coeff. and M the saturation intensity, ees satisfactorily with the observations, and $|K|$ s been derived for each material. An inverse ationship between H_N and the initial susceptibility shown to account quantitatively for the magnetic onance observed in high-permeability materials at ch lower frequencies. A.

538.221 : 537.226.2

Dimensional effects resulting from a high dielectric nstant found in a ferromagnetic ferrite. *See Abstr.* 41

538.222

66. Paramagnetic susceptibility of alloys of nsition elements with tellurium. F. M. GALPERIN D T. M. PEREKALINA. *Dokl. Akad. Nauk, SSSR*, (*No.* 1) 19–22 (1949) *In Russian.*

VTe (50 atomic %) was found to obey Curie's law th $\mu_{eff} = 1{\cdot}7$ Bohr magnetons. Alloys of Cr th Te (in the range from 50 to 70 atomic %) were romagnetic, with Curie points from 360°K to 5°K. NiTe (50 atomic %) had a practically nperature-independent paramagnetism. CoTe (50 omic %) had a non-linear magnetization curve ggesting anti-ferromagnetism. D. SHOENBERG

538.222

67. Some magnetic properties of chromium tassium alum below the Curie-point. M. J. STEENND, D. DE KLERK AND C. J. GORTER. *Physica*, , 711–20 (*Sept.*, 1949).

Details are given on the remanence and hysteresis ects occurring at very low temps. in a sphere of rome alum described in a previous paper [Abstr. 2 (1950)]. From these a data temp. determination n be derived which is in rough agreement with former easurements. A.

538.222

68. Automatic registration of paramagnetic sonance absorption curves. L. GIULOTTO AND L. SETTI. Letter in *Nuovo Cim.*, **6**, 594–5 (*Nov.*, 49) *In Italian.*

538.222

69. Magnetic properties of palladium alloys. WUCHER. *C.R. Acad. Sci., Paris*, **229**, 1309–10 *ec.* 14, 1949) *In French.*

Measurements of the paramagnetism of alloys of l with Cu, Ag, Au, Al, Sn, Pb and Sb show that e Curie constant of Pd does not vary with the ctronic concentration (atomic % × valency) of the ded metal up to 20% concentration. Although ving the same electronic configuration and Curie nstant, Pd thus behaves differently in alloys from , for which the Curie constant falls linearly as the ctronic concentration increases. C. E. WEBB

538.222

3270. Some aspects of paramagnetic relaxation. A. WRIGHT. *Phys. Rev.*, **76**, 1826–38 (*Dec.* 15, 1949).

Concerns the effect of interactions inside the spin system in giving a finite line width to the energy absorption lines in an oscillating magnetic field. The principal calculations are of absorption coeffs. at low frequencies for Cu salts. Low frequency absorption in a perp. field is discussed on the basis of a Gaussian approximation, and the agreement with the experiments of Volger, Vrijer and Gorter is good [Abstr. 1275 (1948)]. It is shown that quantitative calculations only emphasize the discrepancy, pointed out by Broer, between theory and experiment for low frequency absorption in a parallel constant field. An explanation of the discrepancy is given in terms of the difficulty in resolving out the different lines in this case, due to the exchange broadening of the Larmor line, in contrast to the exchange narrowing of the Larmor line in a perp. field. A calculation of the isolated susceptibility of a spin system is given for strong fields; it is found to be 0·80 of the thermodynamic or adiabatic susceptibility of Casimir and du Pré, even in the absence of exchange. A.

538.222

3271. Determination of *g*-values in paramagnetic organic compounds by microwave resonance. A. N. HOLDEN, C. KITTEL, F. R. MERRITT AND W. A. YAGER. Letter in *Phys. Rev.*, **77**, 147–8 (*Jan.* 1, 1950).

538.222

3272. Hyperfine structure and exchange narrowing of paramagnetic resonance. C. H. TOWNES AND J. TURKEVICH. Letter in *Phys. Rev.*, **77**, 148 (*Jan.* 1, 1950).

24 000 Mc/s waves were transmitted through a TE_{01} cavity with a small amount of the free radical $(C_6H_5)_2N\text{–}NC_6H_2(NO_2)_3$ placed on the axis. The transmitted power was reduced by a factor of 3 with 2 mg of the radical and the field (about 8 000 oersted) adjusted to give resonance. The $\frac{1}{2}$-width of the resonance at $\frac{1}{2}$-maximum absorption was only 1·45 oersted and this is attributed to exchange narrowing. Confirmation was obtained by measurements of the resonance $\frac{1}{2}$-widths made with the radical dissolved in benzene when the exchange effects should be negligible. G. F. HODSMAN

538.222 : 541.14

The magnetic susceptibilities of europium (II) and (III) ions. *See Abstr.* 3462

538.24

3273. Law of approximation to saturation in polycrystalline nickel. N. S. AKULOV AND N. Z. MIRIAZOV. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 1) 29–32 (1949) *In Russian.*

ELECTROMAGNETISM . ELECTRODYNAMICS
538.3/.5

538.3

3274. Geometry of electromagnetic systems. A. A. BULGAKOV. *Dokl. Akad. Nauk, SSSR.* **66** (*No.* 1) 63–5 (1949) *In Russian.*

538.3

3275. Non-radiating Maxwell waves. G. A. PERKINS. Letter in *Phys. Rev.*, **75**, 1947 (*June* 15, 1949).

538.3 : 530.145

Reciprocity theory of electrodynamics. *See Abstr.* 2921

538.32

3276. Attraction between two infinite parallel currents. A. LIÉNARD. *J. Phys. Radium*, **11**, 1–6 (*Jan.*, 1950) *In French.*

The new official definition of the ampere has drawn attention to the evaluation of the force between parallel currents. Kelvin's inversion method is here employed to evaluate the magnetic field, taking account of the magnetic permeability of the two wires and of the surrounding medium. The forces on the wires are obtained as rapidly convergent series. P. M. DAVIDSON

538.52 : 550.38

3277. The general theory of the earth inductor. K. BURKHART. *Geofis. Pura Appl.*, **15**, 69–89 (*July–Sept.*, 1949) *In German.*

If an earth inductor is used to measure the inclination of the earth's field oscillations may be detected if a string galvanometer is used; simple theory only gives a mean value of the e.m.f. which is sufficient for the more heavily damped moving coil galvanometer. The general theory is developed and it is shown that the sensitivity with which the null position can be found depends on the inclination. The effect of the commutator is considered by the use of Fourier analysis. The calculation of the inductance of the coil is considered for both single and double coils and in particular the effect of the frame and multilayer windings are discussed. A brief list of experimental arrangements is given. J. M. HOUGH

538.56 : 621.317.7.029.6

3278. A Michelson-type interferometer for microwave measurements. B. A. LENGYEL. *Proc. Inst. Radio Engrs.*, **37**, 1242–4 (*Nov.*, 1949).

The optical Michelson interferometer is modified by replacing one of its branches by a directional coupler and a waveguide. The instrument can be used for precision wavelength determination, the measurement of dielectric constants of materials available in sheet form, the determination of reflection from laminated sheets at normal incidence, the study of metal-loaded dielectrics and of parallel-plate metal lens media. An instrument operating at 3·2 cm is described. A.

538.566

3279. On a new method of solving problems of the reflection of electromagnetic waves from thin unclosed surfaces of finite curvature. R. G. MIRIMANOV. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 4) 641–4 (1949) *In Russian.*

538.566

3280. Variation principles for boundary (diffraction) problems of electrodynamics. G. V. KISUNKO. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 5) 863–6 (1949) *In Russian.*

538.566 : 621.392.2

3281. A general process of solution for inhomogeneous cylindrically symmetrical wave fields. H. H. MEINKE. *Z. angew. Phys.*, **1** (*No.* 11) 509–16 (1949) *In German.*

For background see Meinke [Abstr. 7166 (1949)] and Piloty [*Z. angew. Phys.*, **1** (*No.* 10) 441; (*No.* 11) 490–502 (1949)]. The problem is transformed into that of transmission between parallel planes in an inhomogeneous medium. The field at a cylindrical symmetrical inhomogeneity can then be determined if only the field and equipotentials are known for the static case. A. H. W. BECK (R)

538.566 : 621.396.11

3282. Propagation of waves along an infinite spiral. S. KH. KOGAN. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 5) 867–70 (1949) *In Russian.*

538.566 : 621.396.11

3283. A relation between the Sommerfeld theory of radio propagation over a flat earth and the theory of diffraction at a straight edge. H. G. BOOKER AND P. C. CLEMMOW. *Proc. Instn Elect. Engrs, Pt III*, **97**, 18–27 (*Jan.*, 1950).

A new way of visualizing the Sommerfeld theory of propagation over a flat, imperfectly reflecting earth is presented. The main object of this presentation is to facilitate the solution of problems involving propagation near the surface of the earth partly over land and partly over sea, but these applications are not included in this paper. W. J. G. BEYNON (R)

538.566 : 621.396.671

3284. The field of a vertical and horizontal dipole raised above the earth's surface. V. A. FOK. *J. Exp. Theor. Phys., USSR*, **19**, 916–29 (*Oct.*, 1949) *In Russian.*

In the author's book, *Diffraction of Radio-Waves around the Earth's Surface* [Moscow–Leningrad (1946)], a general method was given for finding the sums of series representing the field of a dipole situated on the surface of an ideally spherical earth. The case of a dipole raised *above* the surface is treated in the present paper. The refraction in the atmosphere is allowed for by introducing an equivalent radius a^* instead of the geometrical radius a of the earth. The Hertz functions representing the field components are expanded in series of functions bearing a simple relation to Bessel and Hankel functions, multiplied by the corresponding zonal Legendrian. The integrating process is demonstrated and the attenuation factor and reflection formula are found and discussed. Further sections deal with the horizontal dipole (primary field), the series for the total resultant field and the approximate expressions for it, giving numerical values of the decrements typical for fields above well-conducting ground. B. F. KRAUS (R)

538.566.3 : 551.510.535

3285. The geometrical optics of the ionosphere. K. RAWER. *Rev. Sci., Paris*, **86**, 585–600 (*Sept.–Oct.*, 1948) *In French.*

A comprehensive study of the "geometrical optics" of radio-wave propagation by the ionosphere. 3 conditions for focusing are deduced, viz. for the tangential ray, at the edge of the skipped zone and at the antipodal point. Previous solutions for a parabolic

ver are briefly considered. [See also Abstr. 6600 (1949)]. W. J. G. BEYNON

538.566.3 : 551.510.535 : 621.396.11

3286. The regular behaviour of long and very long waves returned from the ionosphere. *Proc. Phys. Soc., Lond. B*, **63**, 142–4 (*Feb.*, 1950).

Abstracts only of 5 papers delivered at Cambridge conference, July 14–16, 1949. Subjects discussed include effects of l.f. propagation on long-wave navigational aids.

538.566.3 : 621.396.11

3287. Effect of the *D*-ionospheric layer on very low frequency radio waves. W. PFISTER. *J. Geophys. Res.*, **54**, 315–37 (*Dec.*, 1949).

It is shown that a normal Chapman layer exists at the level of about 60 km, which may best be called the normal *D*-layer and which is the subject of this paper. In long-distance propagation an absorption maximum is observed at 45 kc/s. It is attributed to the *D*-layer and is used together with reasonable assumptions of the ionic reactions at the 60 km level to calculate the ion concentration and the rate of ion production. The latter is found to be of the order of $10/cm^3$ sec, which is in agreement with the value obtained from the process of ionization of molecular O at its first ionization potential. Values for the reflection from the layer *v.* frequency have been calculated for different ionizations and for different angles of incidence using wave theory and certain approximations. Transmission values through the layer have been calculated on the basis of ray theory. Calculations of virtual heights also are included. Different conceivable forms of the ion distribution have been taken into consideration. A.

538.566.3 : 621.396.11

3288. Scattering of echoes in the neighbourhood of the *F*2 critical frequencies. R. RIVAULT. *Proc. Phys. Soc., Lond. B*, **63**, 126–8 (*Feb.*, 1950) *In French.*

From the study of ionospheric data recorded at Poitiers (46 *N*°) it appears that 2 sorts of scattered echoes take place in the neighbourhood of *F*2 critical frequencies. The first seems to be produced by the multiplication of magneto-ionic components. This scattering ends with ground sunrise; it exists during both quiet and perturbed ionospheric conditions; it is far more frequent and stronger when the nights are longer. Its existence seems to be connected with nocturnal thermal and convective disorder. The second sort of scattering is recorded mainly during the second part of the night, after *F*2 penetration, at a virtual height of about 800 to 1 200 km. The sharp lower boundary of these reflections, which disappears a few moments after sunrise, leads to the postulation of an ionospheric *G* region, whose existence has been often discussed. This sort of scattering is connected with magnetically disturbed conditions and, chiefly, with meteoritic periods. A.

538.566.3 : 621.396.11

3289. Ionospheric cross-modulation at oblique incidence. L. G. H. HUXLEY. *Proc. Roy. Soc. A*, **200**, 486–511 (*Feb.* 22, 1950).

An account of an extensive series of investigations on ionospheric cross-modulation (wave interaction) in special tests arranged in collaboration with the B.B.C. Special attention is paid to seasonal and nocturnal changes in the cross-modulation and to the theoretical interpretation of the experimental results. It is shown how a variety of evidence is consistent with the assumption that the cross-modulation is highly localized in the *E*-region at one or two regions near the lower of the surfaces of reflection of the wanted and disturbing waves. An estimate is made of the gradients of electronic concentration and collisional frequency at a height of about 86 km. A.

538.566.3 : 621.396.11

3290. Sudden enhancements of very long waves. R. BUREAU. *Proc. Phys. Soc., Lond. B*, **63**, 122–6 (*Feb.*, 1950) *In French.*

During the last 20 years, enhancements of the mean level of atmospherics, on 11 km wavelength, have been associated with some other phenomena such as simultaneous fade-outs of the field intensity of stations on decametric wavelengths, perturbations of terrestrial magnetism or Wolf numbers relative to solar activity. More recently a search has been made for occasions on which the association between the different phenomena is not so close. It has been found that the usual fade-out on short waves does not occur in the same manner on all stations recorded; sometimes an enhancement of short duration takes place at the beginning of the expected fade-out. This enhancement is probably due to the reception of a radiowave radiation from the sun. The author gives some examples of such phenomena which can be used for a better forecasting of radio disturbance due to abnormal solar activity. A.

538.566.3 : 621.396.11

3291. The irregular behaviour associated with solar events. *Proc. Phys. Soc., Lond. B*, **63**, 146–7 (*Feb.*, 1950).

Abstracts only of 3 papers on fade-outs and other effects, delivered at Cambridge conference, July 14–16, 1949 [for one, see Abstr. 3290 (1950)].

538.566.3 : 621.396.81 : 621.396.11

3292. The analysis of observations on spaced receivers of the fading of radio signals. B. H. BRIGGS, G. J. PHILLIPS AND D. H. SHINN. *Proc. Phys. Soc., Lond. B*, **63**, 106–21 (*Feb.*, 1950).

The fading of a radio wave once reflected from an irregular ionosphere is discussed in terms of the variable diffraction pattern produced at the ground. It is pointed out that fading may arise either by a drift of the diffraction pattern past a receiver, or by irregular variations in the pattern, or by both mechanisms together. It is shown how, from observations at 3 receiving points, it is possible to deduce the rate at which the pattern is changing and the velocity with which it drifts over the ground. This velocity is of interest as it may be related to the wind velocity at ionospheric heights in the atmosphere, but the relation of the diffraction pattern to the irregular ionosphere which produces it is not discussed in detail. A.

538.567.3 : 621.385.1.029.6

3293. Note on wave amplification by interaction with a stream of electrons. L. R. WALKER. Letter in *Phys. Rev.*, **76**, 1721–2 (*Dec.* 1, 1949).

Criticizes recent results of Roberts [Abstr. 398

(1950)] on ground of inconsistent neglect of terms of order V^2/C^2. It is also pointed out that the use of retarding structures in, e.g., travelling-wave tubes, is not superfluous as Roberts claimed. A. H. W. BECK

MAGNETIC EFFECTS 538.6

538.632

3294. A new representation of the spontaneous Hall effect. J.-P. JAN. *Helv. Phys. Acta*, **22** (*No.* 6) 581–3 (1949) *In French.*

Refers to the advantages of representing the Hall effect by a conductivity coefficient, $\gamma_\perp$, calculable from RH and the resistivity, ρ [see Abstr. 232 (1931)], and describes determinations of the variation of RH, ρ and $\gamma_\perp$ with temp. in Ni and Fe between $-192°$C and the Curie point, showing that $\gamma_\perp$ increases rapidly as the temp. is reduced. C. E. WEBB

538.652

3295. On the law of approach to saturation of magnetostriction, of the galvano-magnetic, and of other linear effects. G. P. DYAKOV. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 1) 33–7 (1949) *In Russian.*

A law is deduced for the approach to saturation of magnetostriction in a strong magnetic field which is applicable to all linear effects. If the constant λ of the magnetic energetic natural anisotropy is known, measurements of magnetostriction during approach to saturation on a polycrystalline ferromagnetic substance yield the corresponding constant for a monocrystal. If the experimental behaviour of magnetostriction in approaching saturation is known, the constant λ can be deduced. J. JACOBS

538.653.11

3296. Variation of magnetization through shock. L. LLIBOUTRY. *C.R. Acad. Sci., Paris*, **229**, 1307–9 (*Dec.* 14, 1949) *In French.*

Brown's treatment of the effect of static stress on magnetization based on the displacements produced in 3 types of Bloch boundaries [see Abstr. 2600 (1949)] is applied to calculate the corresponding effect of stresses set up by shock in an Fe bar, allowing for the currents induced in the bar. Good agreement between calculated and observed changes in magnetization is obtained in fields small compared with the coercive force, and it is suggested that the effect may be applied to measure the max. value of an impulsive stress. C. E. WEBB

538.665

3297. Thermal effects of the process of magnetization in weak fields. L. F. BATES. *J. Phys. Radium*, **10**, 353–63 (*Dec.*, 1949) *In French.*

A résumé of measurements of the thermal changes accompanying changes of magnetization in weak and medium fields in Ni, Fe, Co and various alloys [see Abstr. 147 (1941), 1706 (1943), 2184 (1947), 1278 (1948)] with a brief discussion of Stoner and Rhodes' theory of these effects [Abstr. 5572 (1949)]. A short account is also given of observations on the variation with H of the spacing of Bitter lines on a 2·8% Si-iron crystal, which agree generally with Néel's theory. C. E. WEBB

THEORY OF SOLID STATE 539.11

539.11 : 539.153.2 : 548.3

3298. Structural investigations by means of nuclear magnetism. I. Rigid crystal lattices. H. S. GUTOWSKY, G. B. KISTIAKOWSKY, G. E. PAKE AND E. M. PURCELL. *J. Chem. Phys.*, **17**, 972–81 (*Oct.*, 1949).

Experimental absorption line shapes at nuclear magnetic resonance are given for several simple assemblies of nuclei, with spin ½, in the solid state at temps. between 90° and 95°K. Analysis of these data is facilitated by the theory of Van Vleck. 1,2-dichloroethane exhibits a proton resonance with line structure characteristic of nuclear magnetic moments interacting in pairs to produce the broadening of the absorption line. Consideration of both fine structure and second moment leads to an inferred H–H distance of $1·71 \pm 0·02$ Å in the $—CH_2Cl$ group. In conjunction with the expected C–H bond distance of from 1·09 Å to 1·10 Å, this implies that the H–C–H bond angle is between 4° 30′ and 9° < tetrahedral. Absorption line shapes for the proton resonance in 1,1,1-trichloroethane and NH_4Cl are given as characteristic respectively of equilateral 3-spin and tetrahedral 4-spin systems. Less conclusive studies of perfluoroethane and diborane are presented. A detailed analysis of data on NH_4 fluoride, chloride, and bromide yields a value of $1·025 \pm 0·005$ Å for the N–H distance in the NH_4 ion. Some general aspects of the use of nuclear magnetism in structural investigations are discussed briefly. A.

539.11 : 548.7

3299. The triple-dipole interaction between atoms and cohesion in crystals of the rare gases. B. M. AXILROD. Letter in *J. Chem. Phys.*, **17**, 1349 (*Dec.*, 1949).

MOLECULAR STRUCTURE 539.13

539.132

3300. Formulas and numerical tables for overlap integrals. R. S. MULLIKEN, C. A. RIEKE, D. ORLOFF AND H. ORLOFF. *J. Chem. Phys.*, **17**, 1248–67 (*Dec.*, 1949).

539.132

3301. A theoretical calculation of the parameters α and β used in the molecular orbital method. J. VAN DRANEN AND J. A. A. KETELAAR. Letter in *J. Chem. Phys.*, **17**, 1338–9 (*Dec.*, 1949).

539.132

3302. A new method of calculating resonance energies. R. G. PEARSON. Letter in *J. Chem. Phys.*, **17**, 1342–3 (*Dec.*, 1949).

539.132

3303. A one-dimensional treatment of the hydrogen molecule ion. M. WALSH AND F. A. MATSEN. Letter in *J. Chem. Phys.*, **17**, 1343 (*Dec.*, 1949).

539.132

3304. The potential energy in conjugated polyenes and the effective nuclear charge of the carbon atom. N. S. BAYLISS. Letter in *J. Chem. Phys.*, **17**, 1353 (*Dec.*, 1949).

539.132

05. Energy differences in liquid dichloro- and romoethane rotational isomerism. VI. D. H. NK, R. E. KAGARISE AND D. W. E. AXFORD. tter in *J. Chem. Phys.*, **17**, 1354 (*Dec.*, 1949).

539.132

06. Vibration potential function and structure of H_3 and AsH_3 molecules. J. DUCHESNE AND OTTELET. Letter in *J. Chem. Phys.*, **17**, 1354–5 *ec.*, 1949).

539.132

07. Energy levels of aromatic hydrocarbons. P. CRAIG. Letter in *J. Chem. Phys.*, **17**, 1358 *ec.*, 1949).

539.132

08. Polar structures in the theory of conjugated olecules. I. Identification of the ethylene π-electron ates. D. P. CRAIG. *Proc. Roy. Soc. A*, **200**, 272–83 *an.* 6, 1950).

539.132

09. Polar structures in the theory of conjugated olecules. II. Symmetry properties and matrix ements for polar structures. D. P. CRAIG. *Proc. oy. Soc. A*, **200**, 390–401 (*Feb.* 7, 1950).

The inclusion of polar structures in the valence-ond theory of π-electrons entails some additions to e usual formalism. The symmetry properties of ts of structures, both non-polar and polar, and the atrix elements that come into energy calculations, e dealt with. Using the work of part I [see pre-ding Abstr.], and the conclusions of this part, the ergy parameters for work with polar structures are aluated. A.

539.132

10. Polar structures in the theory of conjugated olecules. III. The energy levels of benzene. D. P. RAIG. *Proc. Roy. Soc. A*, **200**, 401–9 (*Feb.* 7, 1950).

The energy levels of benzene are calculated from a asis consisting of the 5 non-polar structures and polar structures, using the method given in part II receding Abstr.). The role of polar structures is scussed. The results include a suggested new ssignment for the 2 080 Å bands of A_{1g}–E_{2g}, instead A_{1g}–B_{1u} as required by molecular orbital theory. n intense A_{1g}–E_{1u} transition is calculated at 7·9 eV stead of the observed 6·7 to 7·0 eV. The disagree-ent with molecular orbital theory, to be dealt with ore fully in a later paper, is briefly discussed. A.

539.132

11. Configurational interaction in molecular orbital eory. A higher approximation in the non-empirical ethod. D. P. CRAIG. *Proc. Roy. Soc. A*, **200**, 74–86 (*Feb.* 22, 1950).

539.132

12. Electronic wave functions. I. A general ethod of calculation for the stationary states of any olecular system. S. F. BOYS. *Proc. Roy. Soc. A*, **00**, 542–54 (*Feb.* 22, 1950).

Deals with the general theory of obtaining numerical ectronic wave functions for the stationary states of oms and molecules. It is shown that by taking aussian functions, and functions derived from these y differentiation with respect to the parameters, mplete systems of functions can be constructed appropriate to any molecular problem, and that all the necessary integrals can be explicitly evaluated. These can be used in connection with the molecular orbital method, or localized bond method, or the general method of treating linear combinations of many Slater determinants by the variational procedure. This general method of obtaining a sequence of solutions converging to the accurate solution is examined. It is shown that the only obstacle to the evaluation of wave functions of any required degree of accuracy is the labour of computation. A modification of the general method applicable to atoms is discussed and considered to be extremely practicable. A.

539.133

3313. Rotation isomerism in certain halogenated hydrocarbons. J. GOUBEAU AND H. PAJENKAMP. *Acta Phys. Austriaca*, **3** (*Nos* 2–3) 283–95 (1949) *In German.*

The Raman spectra of mono- and di-halogenated hydrocarbons show more lines characteristic of the carbon-halogen bonds than have been previously reported and their presence can be interpreted only by the existence of rotation isomerism. The intensity relationship of two characteristic frequencies in respect of temperature has been estimated and distinct changes, which are shown in certain cases, correspond with the existence of a temperature-dependent equilibrium of rotational isomeric molecular form. The heat of transition of rotation isomerism has been calculated for 7 compounds.

W. R. ANGUS

539.133

3314. Physical properties of molecules and group theory. F. G. FUMI. Letter in *Nuovo Cim.*, **6**, 591–3 (*Nov.*, 1949) *In Italian.*

A table is given, for all crystallographic symmetry groups, of the non-vanishing independent components of the dipole moment, the polarizability and the moment of inertia of a molecule. L. PINCHERLE

539.133

3315. Dipole moment and restricted rotation in some chlorinated hydrocarbons. R. A. ORIANI AND C. P. SMYTH. *J. Chem. Phys.*, **17**, 1174–8 (*Dec.*, 1949).

539.133

3316. On the theory of the π-electron system in porphines. W. T. SIMPSON. *J. Chem. Phys.*, **17**, 1218–21 (*Dec.*, 1949).

539.133

3317. A normal coordinate analysis of the planar vibrations of substituted ethylenes. I. CH bending modes. P. TORKINGTON. *J. Chem. Phys.*, **17**, 1279–88 (*Dec.*, 1949).

539.133

3318. Complete sets and redundancies among small vibrational coordinates. J. C. DECIUS. *J. Chem. Phys.*, **17**, 1315–18 (*Dec.*, 1949).

539.133

3319. Hexacovalent bond orbitals. I. G. H. DUFFEY. *J. Chem. Phys.*, **17**, 1328–9 (*Dec.*, 1949).

539.133 : 535.343.3–14

Nuclear and molecular information from the microwave spectrum of FCl. *See Abstr.* 3054

ATOMIC STRUCTURE . ISOTOPES 539.15

539.152

3320. On the spectrum of a system consisting of a positron and electron. V. B. Berestetskiĭ. *J. Exp. Theor. Phys., USSR*, **19**, 1130–5 (*Dec.*, 1949) *In Russian.*

Calculation of the fine structure of the positronium levels. The exchange interaction produces additional splits of the *S*-states (by comparison with the ordinary "superfine" structure). In the Zeeman phenomenon the linear effect is missing.

B. F. KRAUS

539.152.1

3321. Some peculiarities in the distribution of the levels in atomic nuclei. L. V. Groshev. *Dokl. Akad. Nauk, SSSR*, **65** (*No.* 6) 823–6 (1949) *In Russian.*

539.152.1

3322. The effect of nuclear shells upon the pattern of the atomic species. W. D. Harkins. Letter in *Phys. Rev.*, **76**, 1538–40 (*Nov.* 15, 1949).

A continuation of a previous paper [see Abstr. 1909 (1950)]. The magic neutron numbers are shown to have a greater effect on the pattern than have the magic proton numbers. B. ROSE

539.152.2

3323. Spins, magnetic moments, and nuclear structure. G. J. Bene, P.-M. Denis and R.-C. Extermann. *Helv. Phys. Acta*, **22** (*No.* 6) 606–9 (1949) *In French.*

The relation between the spin and magnetic moment are discussed. Graphs are presented showing the relation of the magnetic moment and the atomic number of a nucleus for Z even and N odd, and Z odd and N even. The first curve is smooth and symmetrical about the Z axis, the positive and negative branches corresponding to spin $\frac{3}{2}$ and $\frac{1}{2}$ respectively. The second curve has discontinuities at Z values corresponding to $N = 8, 20, 50, 82, 126$.

J. HUGHES

539.152.2

3324. Hyperfine structure and nuclear moment of Pb^{207}. A. L. Schawlow, J. N. P. Hume and M. F. Crawford. Letter in *Phys. Rev.*, **76**, 1876 (*Dec.* 15, 1949).

Using the Goudsmit–Fermi–Segre formula the nuclear moment of Pb was calculated from the hyperfine structure of the s levels of Pb IV, deduced from the measured levels of Pb III. A value 18% below the nuclear induction measurement was obtained. The values agreed when the spectroscopic value was increased by 15% due to the finite volume of the nuclear charge, and a further 3% due to the volume distribution of the magnetic moment.

J. HUGHES

539.152.2

3325. The influence of nuclear structure on the hyperfine structure of heavy elements. A. Bohr and V. F. Weisskopf. *Phys. Rev.*, **77**, 94–8 (*Jan.* 1, 1950).

The influence on the h.f.s. of the finite size of the nucleus is considered and the effect is calculated for simple models of the nuclear magnetism. It is pointed out that the distribution of magnetic dipole density over the nuclear volume may vary greatly from nucleus to nucleus depending on the relative contributions of spin and orbital magnetic moments to the total nuclear moment. On this basis an attempt is made to interpret the observed discrepancy between the h.f.s. ratio of the Rb isotopes and the ratio of the magnetic moments as determined by the magnetic resonance method. A study of such anomalies may give some information regarding the structure of nuclear moments, in particular, regarding the nuclear g_L-factor. A.

539.152.2

3326. The electric quadrupole moment of the deuteron. G. F. Newell. Letter in *Phys. Rev.*, **77**, 141 (*Jan.* 1, 1950).

By means of the variation principle, a new 6-parameter electronic wave function has been determined for the ground state of the HD and D_2 molecules. The field gradient thus calculated leads to the value $Q = 2{\cdot}766\times10^{-27}$ cm^2 for the interaction energy. It was not found possible to reduce the error below 0·6%. A.

539.152.2 : 537.133

3327. A precise determination of the proton magnetic moment in Bohr magnetons. J. H. Gardner and E. M. Purcell. *Phys. Rev.*, **76**, 1262–3 (*Oct.* 15, 1949).

The ratio of the precession frequency of a proton ω_p to the cyclotron frequency of a free electron ω_e in the same magnetic field was determined. The proton resonance absorption in mineral oil was observed at 14·24 Mc/s, by the bridge technique. An electron beam passed into an evacuated waveguide, where the beam current was limited by a space charge potential minimum. Exciting the waveguide with a weak microwave field produced a sharp max. in the beam current at the resonant frequency, approximately 9 360 Mc/s. The magnetic field was modulated at 60 c/s, and the two resonances displayed simultaneously on an oscilloscope. The frequency ratio was determined by comparing the 657th harmonic of the proton frequency with the electron frequency. Uncorrected for diamagnetism, $\omega_e/\omega_p = 657{\cdot}475 \pm 0{\cdot}008$, and applying the diamagnetic correction the proton magnetic moment was $\mu_p = (1{\cdot}52100 \pm 0{\cdot}00002)\times10^{-3}$ Bohr magnetons. The agreement between this value, and that obtained from a comparison of the proton g-factor and the g-factor of a $^2S_{\frac{1}{2}}$ state, after applying the factor $2(1 + \alpha/2\pi)$, was interpreted as confirming the correction to the spin moment of the electron. J. HUGHES

539.153

3328. The width of an energy level of an atom with high principal quantum number. O. B. Firsov. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 3) 357–9 (1949) *In Russian.*

This is discussed in relation to density fluctuations of the gas surrounding the atom. The electrons are not excited by collisions of the atom with the gas molecules as is the case if the principal quantum number n is small; for the de Broglie wavelength is $>$ the effective extent of the exciting field. The shift of the energy level is independent of the type of atom and of n provided n is large. The $\frac{1}{2}$-width of the

ergy level for large n and N, the density of the citing gas molecules, is $\propto N^{\frac{1}{2}}$ and n^{-3}. J. JACOBS

539.153

29. Tables of oscillator strengths and transition obabilities in atoms with a small number of electrons. . G. VESELOV. *J. Exp. Theor. Phys., USSR*, **19**, 9–64 (*Nov.*, 1949) *In Russian.*

One-electron transitions of type (*a*) 2*p*–1*s* and) 2*p*–2*s* in atoms and ions are investigated. In (*a*) cillator strength f is independent of the effective clear charge Q in 1-electron atoms but increases th Q in 2-electron ones; in (*b*) f decreases like $^{-1}$ in both cases. For 1- or 2-electron atoms the ansition probabilities are $\propto Q^4$ in (*a*), to Q in (*b*). rom these a comparison of lifetimes is made, the nglet state being $\frac{1}{80}$ of the triplet one in the neutral e atom. J. JACOBS

539.153.4

30. Electronic wave functions. II. A calculation r the ground state of the beryllium atom. S. F. BOYS. *oc. Roy. Soc. A*, 125–37 (*March* 7, 1950).

An approximate wave function expressed in terms exponential functions, spherical harmonics, etc., ith numerical coefficients has been calculated. By e energy criterion it gives a more accurate result an the Hartree result, the best previously known. his has been calculated as a trial of a fresh method calculating atomic wave functions. A linear mbination of Slater determinants is treated by the riational method. The results suggest that this will ovide a more powerful and convenient method than as previously been available for atoms with more an 2 electrons. A.

539.155.2

331. The periodic law of atomic nuclei. Specific uclear charge and the periodic system of isotopes. . P. ZNOĬKO. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 5) 37–42 (1949) *In Russian.*

In order to study regularities in nuclear properties he specific nuclear charge Z/A for every known otope is plotted against A (atomic wt.). Analyses f the graphs obtained establish the existence of 4 eriods of atomic nuclei apart from the O group and ncomplete 6th group. All points in the same vertical ne correspond to isobaric isotopes. The isotopes of ach element can be joined by hyperbolae. The uclei of the elements are disposed such that for $Z/A = 0{\cdot}5$ all the nuclei having an isotopic number f 0 ($j = A - 2Z$) lie on a straight line. All the emaining nuclei lie on curves for which j can be ± 1, 2, 3, etc., and which are called isotopic curves. hese curves asymptotically approach the straight ine $j = 0$, $Z/A = 0{\cdot}5$, thus isotopic curves for $= -1$, -2, etc., describe nuclei of positron emitters nd are mirror images of curves $j = 1, 2$, etc. Certain onclusions are drawn from these curves: (1) stable uclei without exception lie in the comparatively arrow range of Z/A from 0·5 to 0·4; (2) it is estab-ished that a periodic alternating β^- and β^+ activity an be regarded as a function of Z/A, so that a hemical element can be regarded as some isotopic eriod in the development of the nuclear mass of a iven charge having in view the consecutive formation f heavier nuclei; (3) the fundamental significance of α-bonds and free neutrons in the structure of complex nuclei is stressed, the α-bonds being related to Z/A. W. HUGHES

539.155.2

3332. The periodic law of atomic nuclei. Chemical analogues of elements in the periodic system of atomic nuclei. A. P. ZNOĬKO. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 6) 1021–4 (1949) *In Russian.*

[See preceding Abstr.]. When the specific nuclear charge Z/A is plotted against Z for even and odd values of Z for the primary (i.e. the most abundant), isotopes within the limits of the 4 main periods there is observed a periodic repeated rise and fall in the value of Z/A from each even to the next odd element. The graph defines the beginning and end of each type of nuclear structure and serves as a basis for forming a periodic system of elements. In the periodic table constructed the physical periods of the atomic nuclei are disposed vertically while the type of atomic nuclei is shown horizontally. Alongside the symbol for each element the isotopic number $j = (A - 2Z)$ and Z/A are given for the primary isotopes. The development of the electronic structure in the periods is considered and it is concluded that the structure of the electronic shells of the atoms is connected with the change of structure and change in Z/A of complex nuclei in the system of elements, this change in Z/A should depend not only on the amount of free neutrons but also on the mutual distribution of particles in complex nuclei. W. HUGHES

539.155.2

3333. Isotopic constitution of sulphur in meteorites and terrestrial objects. A. TROFIMOV. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 2) 181–4 (1949) *In Russian.*

539.155.2

3334. Apparatus for isotope separation by thermal diffusion. W. W. WATSON, L. ONSAGER AND A. ZUCKER. *Rev. Sci. Instrum.*, **20**, 924–7 (*Dec.*, 1949).

A compact, all-metal, multi-stage thermal diffusion apparatus for the separation of isotopes in quantity in non-corrosive gases at any pressure up to 175 lb/in² is described. For a particular gas the proper pressure may be well-enough calculated in advance as that giving maximum separation factor in the last column only. Operating with Ne at 3 atmos. pressure, and using 12 m of column consuming 4·9 kW for 260 hr, 7 l of gas with a Ne^{22} content of 93·4% were produced. A.

539.155.2

3335. A naturally occurring odd-odd isotope of vanadium. W. T. LELAND. Letter in *Phys. Rev.*, **76**, 1722–3 (*Dec.* 1, 1949).

An isotope of mass 50 was observed with an abundance of $0{\cdot}23 \pm 0{\cdot}01\%$. No evidence was found of its radioactivity, so there are now 3 stable isobars of mass 50, Cr^{50}, V^{50} and Ti^{50}. J. HUGHES

539.155.4 : 548.73

3336. The pykno-X-ray method for determining atomic masses. T. BATUECAS. *Nature, Lond.*, **165**, 61–2 (*Jan.* 14, 1950).

The accuracy of measurement of the densities and unit-cell volumes of crystals is now sufficient for the determination of molecular weights and hence atomic

weights to 5 significant figures. The density and cell volume should preferably be measured at the same temp. and on the same specimen. A. J. C. WILSON

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16.08

3337. Measurements of radioactivity. L. F. CURTISS. *Circ. Nat. Bur. Stand., Wash.* (*No.* 476) 1–84 (*Oct.* 15, 1949).

An elementary survey of experimental techniques of nuclear physics, including: the detection and measurement of nuclear radiations by counters and ionization chambers; production of artificial radioactive isotopes; production, properties, detection and energy measurement of neutrons, protons, deuterons and α-particles; β-ray measurements; coincidence techniques; ½-life determinations; tracer measurements; radioactive standards; geological data from radioactive minerals; health protection.

L. R. SHEPHERD

539.16.08

3338. Rapid response radiation alarm. R. L. MACKLIN AND E. R. ROHRER. Note in *Rev. Sci. Instrum.*, **20,** 965–6 (*Dec.*, 1949).

539.16.08 : 537.542

Ionisation chambers and counters—experimental techniques. *See Abstr.* 3200

539.16.08 : 614.8

3339. A portable roentgenmeter for field use. C. C. LAURITSEN. Note in *Rev. Sci. Instrum.*, **20,** 964 (*Dec.*, 1949).

539.16.08 : 778.3

3340. Detection of radioactive atoms in the air with nuclear emulsions. Č. JECH. Letter in *Phys. Rev.*, **76,** 1731–2 (*Dec.* 1, 1949).

Nuclear track emulsions have been used as a detector for low activities of radioactive contaminated air. By directing a stream of air towards a nuclear plate, dust is collected together with radioactive atoms on the surface of the emulsion. The aspiration of 125 cm³ of air containing $1{\cdot}5 \times 10^{-13}$ Curie/cm³ of Rn reveals α-tracks after processing of the plate. 280 tracks were counted, which assuming radioactive equilibrium in the air, shows that 20% of active deposit was collected with the dust on the plate. On the average 35 α-tracks were counted after aspirating 1 600 cm³ of free atmospheric air on a given area of the plate. Most of the tracks were identified as RaC α-tracks. Assuming 20% efficiency this would correspond to a Rn concentration of 10^{-15} Curie/cm³. R. H. HERZ

539.16.08 : 778.3

3341. On the use of the photographic emulsion in the determination of the radioactivity of rocks by means of α-ray tracks. R. COPPENS. *J. Phys. Radium,* **11,** 21–32 (*Jan.*, 1950) *In French.*

Various minerals have been investigated in regard to their content and distribution of radioactive traces of U and Th, using the nuclear track emulsion technique. The ratio of the concentration of Th and U has been determined by measuring the length and the number of α-tracks per unit area. Th distribution of radioactive traces has been found t occur in 3 different characteristic states: (*a*) in ver minute (several square microns) inclusions of hig concentration of radioactive material; (*b*) in crystal up to 1 mm diameter which contain a non-uniform distribution of Th and almost no traces of U (*c*) small grains of several 10 square microns with high concentration of Th. The minerals examine cover granite, gneiss, quartz, mica and sand c various origin. R. H. HERZ

539.162 : 539.16

3342. Systematics of alpha-radioactivity. I. PERLMAN, A. GHIORSO AND G. T. SEABORG. *Phys. Rev.* **77,** 26–50 (*Jan.* 1, 1950).

Correlations of α-decay energies in terms of mass number and atomic number have been made for a of the α-emitting species, now numbering over 100 For each element isotopes show increase in α-energy with decrease in mass number except in the region c 126 neutrons where there is an explainable reversa This reversal has the effect of creating a region c relatively low α-energy and long ½-life at low mas numbers for such elements as At, Em, Fr and possibl higher elements as had been noted already for P and Po. Methods and examples of using α-decay data to define the energy surface in the heavy elemen region are discussed. The regularities in α-decay are used for predictions of nuclear properties, includin predictions of the β-stable nuclides among the heav elements. The ½-life *v.* energy correlations show tha the even-even nuclides conform well with existin α-decay theory, but all nuclear types with odd nucleons show prohibited decay. The reason for thi prohibition is not found in spin changes in th α-emission but in the assembly of the component of the α-particle, and this theory is discussed furthe in terms of observations made on nuclides havin 2 or more α-groups. Using most of the even-even nuclei to define "normal nuclear radius" calculation are now able to show the shrinkage in the regions o Pb and of 126 neutrons to amount to about 10% The much greater change in "effective radius" fo Bi isotopes can be dissociated into the effects of odd nucleons superimposed on the actual decrease i nuclear radius. The simple expression $r = 1{\cdot}48A^{\frac{1}{3}}$ 10^{-13} cm seems to fit the data for the even-even nuclei outside of the region of 126 neutrons bette than more complex functions. A

539.16

3343. The mechanism of the physical method o separating the nuclear isomer. A. S. KARAMYAN *Dokl. Akad. Nauk, SSSR,* **64** (*No.* 4) 491–4 (1949 *In Russian.*

539.16

3344. The problem of the physical method o separation of nuclear isomers. A. S. KARAMYAN *Dokl. Akad. Nauk, SSSR,* **68** (*No.* 2) 269–71 (1949 *In Russian.*

539.16

3345. The problem of the increase of concentratio of the artificially radioactive elements. A. S. KARAM YAN AND G. E. KOGAN. *Dokl. Akad. Nauk, SSSR* **68** (*No.* 3) 477–9 (1949) *In Russian.*

539.163

6. The disintegration scheme of Tm^{170}. J. S. ASER. Letter in *Phys. Rev.*, **76**, 1540–1 (*Nov.* 15, 9).

Pile irradiated pure Tm_2O_3 was examined in a thin s β-spectrometer and by coincidence experiments. Kurie plot of the β-spectrum showed 2 partial ctra, 90% of the disintegrations occurring with an l-point 970 ± 5 keV (kinetic energy) and 10% with l-point 900 ± 20 keV. *K*, *L* and *M* conversion es due to an 83·9 keV transition were observed in primary spectrum and the presence of uncon- ted 83·9 keV γ-rays was confirmed with a Pb diator which gave *L* and *M* photoelectron lines. e results were consistent with a simple decay eme in which the 970 ± 5 keV transition is to ground state Yb^{170} and the lower energy nsition (886 ± 5 keV) to an 83·9 keV level. γ coincidence measurements indicated that ~0·1 the transitions from this excited state are uncon- rted. The conversion coeffs. deduced from line ights in the primary spectrum are $\alpha_K = 0{\cdot}08$, $= 0{\cdot}55$ and $\alpha_M = 0{\cdot}17$. L. R. SHEPHERD

539.163.1

47. Upper limit for the lifetime of the 411 keV cited state of Hg^{198}. R. E. BELL AND H. E. PETCH. tter in *Phys. Rev.*, **76**, 1409–10 (*Nov.* 1, 1949).

β–γ radiations from Au^{198}–Hg^{198} were examined the delayed coincidence technique using resolving mes $< 10^{-8}$ sec. Anthracene scintillation counters ere used with photomultipliers operated at very gh voltage to avoid the use of amplifiers, before the ystal diode mixer stage. Delays were introduced y varying cable lengths to the mixer. Only coinci- ences due to pulses > some fixed size in each unter were recorded. Curves of coincidence rate gainst time of delay of pulses from either counter ere obtained for Co^{60} γ–γ, Cs^{134} γ–γ and Au^{198} β–γ incidences. There was no significant difference etween the resulting curves. It was possible to set n upper limit of 3×10^{-9} sec for the 411 keV excited ate of Hg^{198}. L. R. SHEPHERD

539.163.1

348. The physical properties of polonium. III. The alf-life of polonium. W. H. BEAMER AND W. E. ASTON. *J. Chem. Phys.*, **17**, 1298–300 (*Dec.*, 1949).

The ½-life has been measured by a calorimetric ethod. The reproducibility and precision of the lata is ⩾ has been previously reported. The value s found to be 138·3 ± 0·1% d [see Abstr. 3528 1950)]. A.

539.163.1

349. The uranium 234 content of natural uranium nd the specific alpha-activities of the isotopes. C. A. KIENBERGER. *Phys. Rev.*, **76**, 1561–3 (*Dec.* 1, 1949).

The U^{234} content of natural U was determined, by combination of α-counting and mass spectrometer echniques, to be 0·005481 ± 0·000012 weight %. his corresponds to a ½-life of $(2{\cdot}522 \pm 0{\cdot}008)\times 0^5$ yr. In conjunction with this determination, the -lives of the other natural U isotopes were also neasured. A.

539.163.1

3350. A 7×10^{-9} sec isomeric state in $_{79}Au^{197}$. F. K. MCGOWAN. Letter in *Phys. Rev.*, **77**, 138–9 (*Jan.* 1, 1950).

539.163.1

3351. Lifetimes of excited states of Au^{197}, Fe^{57}, Cd^{111}, Hg^{198}, and Tl^{203}. M. DEUTSCH AND W. E. WRIGHT. Letter in *Phys. Rev.*, **77**, 139–40 (*Jan.* 1, 1950).

539.163.1

3352. Lifetimes of mercury and potassium atoms in excited states. B. MISHRA. Letter in *Phys. Rev.*, **77**, 153 (*Jan.* 1, 1950).

539.163.2

3353. Assignment and disintegration scheme of the 6·75-hour molybdenum. D. N. KUNDU, J. L. HULT AND M. L. POOL. *Phys. Rev.*, **77**, 71–4 (*Jan.* 1, 1950).

Contrary to previous reports, *d* bomb. of Mo does not produce any measurable amount of the 6·75 hr Mo activity. The assignment of this activity has, therefore, been reinvestigated and correctly found to be still Mo^{93}. Decay does not take place by positron emission or *K*-capture. A disintegration scheme has been worked out using absorption, β-ray spectrograph, and coincidence counter measurements. By successive emission of 3 γ-rays of energies 0·30, 0·70 and 1·7 MeV of which the first is about 90% internally converted, the 6·75 hr Mo^{93} passes into a long-lived isomeric state. Mo K_α X-rays resulting from the conversion have been found. A.

539.164

3354. On the α–β- and α–*K*-branching of the heaviest natural and artificial radioactive substances. W. JENTSCHKE. *Phys. Rev.*, **77**, 98–101 (*Jan.* 1, 1950).

Based on simple empirical regularities in α-decay properties of the heavy elements, the following substances which show β-emission or *K*-capture should also be α-radioactive with α–β- or α–*K*-branching ratios of at least 10^{-10}: $MsTh_2$, $MsTh_1$, AcK; $_{88}Ra^{225}$, $_{91}Pa^{233}$, $_{93}Np^{234}$, $_{93}Np^{235}$, $_{93}Np^{236}$, $_{93}Np^{238}$, $_{93}Np^{239}$, $_{94}Pu^{241}$, $_{95}Am^{242}$. A.

539.164 : 539.162

Systematics of alpha-radioactivity. *See Abstr.* 3342

539.164 : 539.185 : 541.141

The action of α-particles on benzene. *See Abstr.* 3465

539.165

3355. The problem of the β-disintegration of H^3. M. E. VOIKHANSKIĬ, B. S. DZHELEPOV AND L. A. SLIV. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 5) 829–32 (1949) *In Russian.*

539.165

3356. Measurement of the partial β-spectrum of ThB by the method of coincidences by means of a double β-spectrometer. L. V. GROSHEV AND L. YA. SHAVTVALOV. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 2) 257–60 (1949) *In Russian.*

539.165

3357. Investigation of the angular correlation of the internal conversion electrons. L. I. RUSINOV AND E. I. CHUIKIN. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 6) 1029–32 (1949) *In Russian.*

539.165

3358. The spectrum of inner conversion electrons from an ampoule filled with radium emanation. I–II. G. D. Latyshev, I. F. Barchuk, V. A. Sergienko, Yu. K. Ioffe, V. A. Malev, A. A. Bashilov and K. V. Inozemtsev. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 4) 428–33 (1949) *In Russian.*

539.165

3359. The spectrum of inner conversion positrons corresponding to an emission of 1 414 keV in RaC′. G. D. Latyshev, A. A. Bashilov, I. F. Barchuk, V. A. Sergienko, Yu. K. Ioffe, V. A. Malev and K. V. Inozemtsev. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 4) 434–7 (1949) *In Russian.*

539.165

3360. The spectrum of inner conversion positrons corresponding to an emission of 1 761 keV in RaC′. G. D. Latyshev and B. A. Shakhbazyan. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 4) 438–9 (1949) *In Russian.*

539.165

3361. Beta spectrum of Au^{198}. L. Ya. Shavtvalov. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 7) 633–6 (1949) *In Russian.*

An investigation was made with a magnetic spectrometer. The spectrum is a simple one, with an upper limit of 970 keV. The coeff. of internal conversion for the γ-line of 415 keV energy = 0·007.

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539.165

3362. On the shape of the positron spectrum of Cu^{61}. G. E. Owen and C. S. Cook. Letter in *Phys. Rev.*, **76**, 1536–7 (*Nov.* 15, 1949).

Carrier free Cu^{61} prepared by Ni^{61} (d, $2n$) reaction was evaporated from a W filament on to 0·00025 in Al foil. The film thickness was estimated to be 10^{-4} μg/cm^2 or less than one complete layer of atoms. This was examined in a 6 cm radius of curvature spectrometer and it was found that the excess of positrons below 500 keV (previously reported by several experimenters using thicker sources) was present even with such a thin source. Observations on the I^{131} conversion lines with the same Al backing indicated that backscattering from this produced negligible distortion above 47 keV.

L. R. SHEPHERD

539.165

3363. The β-disintegration of RaE. A. S. Zavelskiĭ, G. Ya. Umarov and S. Kh. Matushevskiĭ. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 12) 1136–40 (*Dec.*, 1949) *In Russian.*

It is shown that the β-spectrum of RaE is a composite one and the upper limits of the partial β-spectra are determined. The conversion of γ-rays, accompanying the disintegration of the RaE, was also investigated and their absorption measured, and also the absorption of the electrons of RaE and RaD. In the β-spectrum of the RaE a great number of slow electrons was found, a fact which does not fit into the Fermi theory. This was also confirmed by absorption experiments with the disintegration electrons.

B. F. KRAUS

539.1

3364. The effect of screening on beta-ray spec and internal conversion. J. R. Reitz. *Phys. Rev.*, 10–18 (*Jan.* 1, 1950).

The Dirac equation for an electron in the field o Thomas–Fermi–Dirac atom is solved numerically the ENIAC for a large number of cases. The resulti wave functions are used to calculate the effect screening (by the atomic electrons) on allow β-spectra and on the internal conversion coeffs. γ-rays. It is seen that the negatron spectra a essentially unaffected by screening; positron spect are affected appreciably in a direction such as increase the number of low energy positrons. Whe a comparison can be made between the prese calculations and previous ones in which the screeni has been neglected, it is seen that the effect of screeni is to increase the conversion coeffs. slightly. Mc of the present calculations, however, are for the sc γ-ray region, for which only approximate formul for the conversion coeffs. exist. Thus the results this paper are used to test the accuracy of the formulae. An attempt is also made to classify number of experimentally observed γ-rays.

539.1

3365. The beta-spectra of Cl^{38}. L. M. Langer *Phys. Rev.*, **77**, 50–3 (*Jan.* 1, 1950).

The β-spectra of the 38 min activity of Cl^{38} w studied in a magnetic lens spectrometer. Th momentum distribution was resolved into 3 group with end points of 4·81, 2·77 and 1·11 MeV. Th highest energy group was found to have a shap characteristic of a once forbidden transition involvin a spin change of 2 units and a change of parity.

539.16

3366. Assignment and characteristic radiations the 14-day tin activity. E. C. Mallary and M. I Pool. *Phys. Rev.*, **77**, 75–6 (*Jan.* 1, 1950).

The Sn isotope which decays with a 14 d ½-life b an isomeric transition is definitely assigned to mas number 117. It was produced by the reaction $Cd^{114}(\alpha, n)$, $Sn^{116}(d, p)$, $Sn^{118}(nf, 2n)$ and $Sn^{117}(nf, n)$ and by the decay of In 117 which is produced by th reaction $Cd^{116}(d, n)$. The cross-section of the reactio $Sn^{117}(nf, n)$ is about 1·8 times > the cross-section o the reaction $Sn^{118}(nf, 2n)$. Characteristic radiation are K and L conversion electrons of 0·146 MeV an 0·171 MeV energy, respectively, Sn X-rays, an 0·175 MeV γ-rays which are about 50% internall converted.

539.16

3367. The beta-spectrum of Ca^{45}. P. Macklin L. Feldman, L. Lidofsky and C. S. Wu. Letter i *Phys. Rev.*, **77**, 137–8 (*Jan.* 1, 1950).

539.165 : 537.533.7

Concerning the question of the resolving power of magnetic spectrograph. *See Abstr.* 3184

539.165 : 778.3

Radiography with beta-rays. *See Abstr.* 3671

539.16

3368. Conversion of a γ-quantum on the β-dis integration electron. I. S. Shapiro. *Dokl. Aka Nauk, SSSR*, **67** (*No.* 1) 53–5 (1949) *In Russian.*

539.166

3369. The angular correlation of the short-path particles and γ-quanta. L. A. KULCHITSKI, G. D. LATYSHEV AND D. G. BALIGINSKI. *Izv. Akad. Nauk, SSR, Ser. Fiz.*, **13** (*No.* 3) 331–8 (1949) *In Russian.*

539.166

3370. The multiplicity of the RaC′ γ-line. G. D. LATYSHEV, I. F. BARCHUK, V. A. SERGIENKO, YU. K. IOFFE, A. A. BASHILOV, V. A. MALEV AND K. V. INOZEMTSEV. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 4) 440–2 (1949) *In Russian.*

539.166

3371. The fine structure of the RaC′ γ-line. II. G. D. LATYSHEV, I. F. BARCHUK, V. A. SERGIENKO, YU. K. IOFFE, V. A. MALEV, A. A. BASHILOV AND K. V. INOZEMTSEV. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 4) 443–6 (1949) *In Russian.*

539.166

3372. The intensity of the components of the fine structure of the RaC′ γ-line. G. D. LATYSHEV, V. A. MALEV AND I. F. BARCHUK. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 4) 447–52 (1949) *In Russian.*

539.166

3373. Gamma-ray of K^{40}. G. A. SAWYER AND M. L. WIEDENBECK. Letter in *Phys. Rev.*, **76**, 1535 (Nov. 15, 1949).

Gamma rays from KCl in the form of a cylindrical shell were detected by means of a stilbene crystal placed inside the cylinder. Light was piped from the crystal to two photomultipliers operated in coincidence and a coincidence counting rate of 0·5/sec (2× background) obtained. The γ-activity of K^{40} was estimated by taking similar observations with calibrated samples of $K^{42}Cl$ mixed with the KCl, the γ-counting efficiency being the same in both cases owing to the nearly equal energies of the two radiations involved (K^{40} = 1·55 MeV; K^{42} = 1·51 MeV). The γ-ray activity of K^{40} was found to be 3·6 ± 0·3 γ-rays/gm of natural K/sec in close agreement with values of other experimenters. L. R. SHEPHERD

539.166

3374. The ratio of L_1 to K capture. M. E. ROSE AND J. L. JACKSON. Letter in *Phys. Rev.*, **76**, 1540 (Nov. 15, 1949).

The ratio of L_1 to K capture in A^{37} has been calculated (*a*) using relativistic wave functions computed on the ENIAC digital computer by Reitz, (*b*) using Hartree wave functions. The values obtained, 8·2% and 8·1% respectively, agree well with an experimental value 8–9% obtained by Pontecorvo *et al.* [*Phys. Rev.*, **75**, 982 (1949)]. The calculations have been carried out over a wide range of Z and results are given in a curve showing the ratio of L_1 to K electron densities at the nuclear radius as a function of Z L. R. SHEPHERD

539.166

3375. Penetration and diffusion of hard X-rays through thick barriers. IV. Multiply-scattered γ-rays: angular distribution. L. V. SPENCER AND F. JENKINS. Letter in *Phys. Rev.*, **76**, 1885–6 (*Dec.* 15, 1949).

A uniform source density of monochromatic γ-rays in a medium is assumed, and it is supposed that the γ-rays all start in the same direction. The distribution in angle of those γ-rays degraded to a given energy E is given graphically for values of E from 2·55 to 0·124 MeV, the initial energy being 5·1 MeV and the medium being Al. An expansion in Legendre polynomials was used to obtain an approx. solution to the integral equation governing the scattering. It was not in general necessary to carry the expansion beyond $l = 4$. A. P. FRENCH

539.166

3376. Search for photons emitted by long-life species of nickel. D. G. THOMAS AND J. D. KURBATOV. Letter in *Phys. Rev.*, **77**, 151–2 (*Jan.* 1, 1950).

539.166 : 537.531.85

3377. Gamma spectroscopy using Compton electrons. B. T. DZHELEPOV AND M. L. ORBELI. *Dokl. Akad. Nauk, SSSR*, **62** (*No.* 5) 615–17 (1948) *In Russian.*

539.166.2

3378. Internal conversion of gamma-rays with pair formation in light elements. V. B. BERESTETSKIĬ AND I. M. SHMUSHKEVICH. *J. Exp. Theor. Phys., USSR*, **12** (*No.* 7) 591–6 (1949) *In Russian.*

Calculations are made of the internal conversion coeffs. of an electric and magnetic multipole emission with pair formation for large energies of γ-quanta and for a small charge of the nucleus.

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539.166.2

3379. Coefficient of internal conversion with pair emission for electric and magnetic radiation of an arbitrary multipole character. I. S. SHAPIRO. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 7) 597–604 (1949) *In Russian.*

Using the Born approximation, calculations are made of the coefficients of pair conversion for electric and magnetic 2^l poles. The influence of the coulomb field of the nucleus is examined, and it is shown that the latter does not affect the character of the differential probability dependence of the process on the multiple character of the radiation.

BOOKHAVEN GUIDE TO RUSSIAN LITERATURE

539.166.74

3380. Higher radiation corrections to the Klein–Nishina-formula. M. R. SCHAFROTH. *Helv. Phys. Acta*, **22** (*No.* 5) 501–36 (1949) *In German.*

The Compton cross-section is calculated up to order e^6, using the covariant subtraction methods of modern electrodynamics. A finite, Lorentz- and gauge-invariant, result is obtained. Calculations are performed both in configuration and momentum space, and the devices required to remove divergencies are discussed. In particular the infrared catastrophe cancels out when the double Compton effect is included. H. MCMANUS

539.166.74

3381. On the scattering of electromagnetic waves by free electrons. I. Classical theory. N. D. SENGUPTA. *Bull. Calcutta Math. Soc.*, **41**, 187–98 (*Dec.*, 1949).

The relativistic form of the Lorentz equation of motion of the electron is solved completely. Scattering is then determined from the Lienard–Wiechert potential corresponding to the electron velocity. The scattered radiation differs in frequency from the

incident radiation; the difference is calculated. The frequencies of the scattered radiation are integral multiples of a basic frequency. L. S. GODDARD

NUCLEAR REACTIONS 539.17

539.172.13

3382. Investigation of the energy of protons formed in the bombardment of Al and Si by deuterons. YU. A. NEMILOV. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 3) 369–71 (1949) *In Russian.*

539.172.13

3383. Angular distribution of protons in the reactions $O^{16}(d, p)O^{17}$ and $Al^{27}(d, p)Al^{28}$. YU. A. NEMILOV. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 4) 609–12 (1949) *In Russian.*

539.172.13

3384. Excitation function of the reaction $O^{18}(p, n)F^{18}$. J.-P. BLASER, F. BOEHM, P. MARMIER, P. PREISWERK AND P. SCHERRER. *Helv. Phys. Acta*, **22** (*No.* 6) 598–9 (1949) *In French.*

Mica (muscovite $Si_3Al_3KH_2O_{12}$) provides a suitable target material and despite the low relative abundance of O^{18}, a strong source of F^{18} can be obtained by p bombardment. A pile of 7 μ mica foils was bombarded by a 6·9 MeV beam of protons. The excitation function of the reaction was obtained as a function of p energy by determining the F^{18} positron activity of successive foils. 6 resonances were found corresponding to p energies of 3·5, 4·2, 4·70, 5·55, 6·13 and 6·65 MeV, the respective cross-sections being 0·9, 1·8, 3·1, 5·7, 3·9 and $4{\cdot}3\times10^{-25}$ cm². A value of 2·5 MeV was obtained for the threshold of the reaction in good agreement with the value estimated from the positron spectrum.

L. R. SHEPHERD

539.172.13

3385. Neutrons from deuterons on Li^6. C. E. MANDEVILLE, C. P. SWANN AND S. C. SNOWDON. Letter in *Phys. Rev.*, **76**, 980 (*Oct.* 1, 1949).

Using a separated Li^6 target and detecting the neutrons in photographic plates, two groups were found, corresponding to the reactions $Li^6(d, n)Be^7$ and $Li^6(d, n)He^4 + He^3$, with relative yields 2 : 1. The Q for the former reaction was 3·30 MeV and it is estimated that no level in Be^7 between $\frac{1}{2}$ and 1 MeV is excited by $> 10\%$ of the disintegrations or by $> 2\%$ in the region 1–2 MeV. B. ROSE

539.172.13

3386. Carrier-free radioisotopes from cyclotron targets. III. Preparation and isolation of $Sb^{122, 124}$ from tin. R. D. MAXWELL, H. R. HAYMOND, W. M. GARRISON AND J. G. HAMILTON. Letter in *J. Chem. Phys.*, **17**, 1340 (*Dec.*, 1949).

539.172.13

3387. Carrier-free radioisotopes from cyclotron targets. IV. Preparation and isolation of Mn^{54} and $Co^{56, 57, 58}$. R. D. MAXWELL, J. D. GILE, W. M. GARRISON AND J. G. HAMILTON. Letter in *J. Chem. Phys.*, **17**, 1340–1 (*Dec.*, 1949).

539.172.

3388. Chemical oxidation states of Cl and N form by the $S^{34}(p, n)Cl^{34}$ and $O^{16}(p, \alpha)N^{13}$ reactions crystals. D. J. MEIER AND C. S. GARNER. Letter *J. Chem. Phys.*, **17**, 1344–5 (*Dec.*, 1949).

539.172.13 : 544

Analysis by nuclear transformation. *See Abs.* 3488

539.172

3389. A contribution to the theory of the nucle photo-effect. T. SEXL. *Acta Phys. Austriaca*, (*Nos* 2–3) 277–82 (1949) *In German.*

The cross-section for nuclear photo-disintegrati is calculated for the nuclei He^3, Be^9, C^{13}, using a α-particle model. A rectangular potential well finite depth represents the interaction between th α-particle aggregate and the unpaired neutron, whic is in a $2p$ shell. The cross-section is obtained terms of the radius and depth of the well.

J. HUGH

539.172

3390. Nuclear photo-processes in light element H. WÄFFLER AND S. YOUNIS. *Helv. Phys. Acta*, 2 (*No.* 6) 614–18 (1949) *In German.*

The angular distribution of the photoprotons fro the disintegration of D, by the 14·8 and 17·5 MeV γ-rays from Li, was measured using a D_2O loade photographic plate. The angular distribution was $I = I_0(0{\cdot}15 \pm 0{\cdot}15 + \sin^2\theta)$, where θ is the angl between the incident γ-ray and the proton. Th cross-section was $7{\cdot}0 \pm 2{\cdot}5\times10^{-28}$ cm². Thes results were interpreted as discriminating against th symmetrical meson theory, but the accuracy wa insufficient to discriminate between the charged an neutral theories. The following cross-sections wer also measured: $C^{12}(\gamma, \alpha)2\alpha$, $0{\cdot}8 \pm 0{\cdot}3\times10^{-28}$ cm² $O^{16}(\gamma, n)O^{15}$ $5{\cdot}4 \pm 1{\cdot}4\times10^{-28}$ cm²; $O^{16}(\gamma, p)N^{1}$ $6{\cdot}8 \pm 1{\cdot}7\times10^{-28}$ cm²; $O^{16}(\gamma, \alpha)C^{12}$ $1{\cdot}8 \pm 0{\cdot}6\times10^{-28}$ cm².

J. HUGHE

539.172.

3391. Photo-disintegration of the deuteron a intermediate energies. J. F. MARSHALL AND E. GUTH Letter in *Phys. Rev.*, **76**, 1879–80 (*Dec.* 15, 1949).

A formula is given which represents the $(\gamma, n$ cross-section up to ~ 20 MeV γ-ray energy. A 50–50 mixture of ordinary and tensor forces i assumed. The form of the expected angular distri bution of disintegration protons with respect to a unpolarized γ-ray beam is also given; the anisotropi part is $\sin^2\theta$ modified by a small interference term Agreement with expt. [Abstr. 498 (1950)] is quit good but does not permit any definite conclusions.

A. P. FRENC

539.172.

3392. High energy photo-disintegration of th deuteron. J. F. MARSHALL AND E. GUTH. Letter i *Phys. Rev.*, **76**, 1880–1 (*Dec.* 15, 1949).

The results are given of calculations of total cross section σ for a square well potential, assumin (*a*) a 50–50 mixture of ordinary and Majorana force (*b*) equal ranges for the singlet and triplet interaction and (*c*) an electromagnetic interaction given b $\boldsymbol{E} \cdot \boldsymbol{r}$ and $\mu \cdot \boldsymbol{H}$ for electric and magnetic dipo transitions respectively (with equivalent expressio

higher poles). σ is plotted over the ranges 20–
MeV for well radii of $2{\cdot}8$ and $1{\cdot}8 \cdot 10^{-13}$ cm,
20–300 MeV for zero radius. Even at 100 MeV
electric dipole interaction accounts for more than
% of σ. Above 100 MeV magnetic contributions
ome important through the decrease of the photo-
tric cross-section. The calculated angular distri-
ion of disintegration protons at 100 MeV γ-ray
rgy is plotted for a well radius of $2{\cdot}8 \cdot 10^{-13}$ cm.
differs markedly from the distribution calculated
pure central forces [Abstr. 411 (1948)]. As a
de to future expts. it is pointed out that, above
MeV, the total cross-section is sensitive to well
ius, and the angular distribution to the mixture of
es. A. P. FRENCH

539.172.3

3. Photo-electric disintegration of the deuteron 6·13 and 17·6 MeV. C. A. BARNES, G. H. AFFORD AND D. H. WILKINSON. Letter in *Nature*, *id.*, **165**, 69–70 (*Jan.* 14, 1950).

-rays from the Li(p, γ) and F(p, γ) processes were d to produce (γ, n) reactions in D at 38 atm. ntained in an ionization chamber of volume 5 cm^3. The disintegration protons were counted, d the γ-ray flux was measured with a graphite ization chamber. The cross-section, in units of $^{-28}$ cm^2, was found to be $21{\cdot}5 \pm 1{\cdot}2$ at $6{\cdot}13$ MeV, d $8{\cdot}5 \pm 1{\cdot}2$ at $17{\cdot}6$ MeV. A. P. FRENCH

539.172.4

4. Determination of the collision cross-section of drogen, deuterium, carbon, and oxygen for fast trons. E. BRETSCHER AND E. B. MARTIN. *Helv. ys. Acta*, **23** (*Nos* 1–2) 15–23 (1950).

539.172.4

5. Nuclear transmutation process with fast trons: a contribution to the verification of statistical clear theory. H. WÄFFLER. *Helv. Phys. Acta*, (*Nos* 1–2) 239–58 (1950) *In German.*

The absolute cross-sections for the (n, p) and $2n$) reactions have been measured for several clei, using (Li + D) as well as (B + D) neutrons a bombarding energy of 500 keV. The isotopes vestigated are the following: (n, p): Fe^{56}, Cu^{64}, Zn^{66}, ^{70}, Se^{76}, Mo^{98}, Ag^{109}, I^{127}, La^{139}. (n, $2n$): N^{14}, F^{19}, ^{9}, Sc^{45}, Ti^{46}, Cu^{63}, Zn^{64}, Ge^{70}, Br^{79}, Zr^{90}, Ag^{107}, ^{124}, Sb^{121}, $Te^{128\ 130}$, J^{127}, Pr^{141}, Ho^{165}. The comrison of the experimental cross-sections with the lues computed from the statistical theory of nuclear nsmutations shows for (n, $2n$) reactions agreement thin a factor of 2, while for (n, p) processes the perimental cross-sections are $>$ the theoretical lues by a factor of 3 to 14. Some possible explanaons for this discrepancy are discussed. A.

539.172.4

6. Probability problems in nuclear chemistry. II. . BASSALI. *Proc. Roy. Irish Acad.*, **52A** (*No.* 14) 1–201 (*May*, 1949).

The integral equation of Schrödinger [Abstr. 61 (1948)] is solved by standard methods, to give e probability distribution of fission inside a sphere, d the neutron production per fission to produce a ain reaction. G. J. KYNCH

539.172.4

3397. On the relative yields of fission caesium isotopes. M. G. INGHRAM, D. C. HESS, JR. AND J. H. REYNOLDS. Letter in *Phys. Rev.*, **76**, 1717–18 (*Dec.* 1, 1949).

A sample of fission Cs, separated from U fission products, was analysed using a 60° mass spectrometer with a surface ionization type of source. The yields, normalized to $Cs^{137} = 1{\cdot}000$, were:

Mass	133	134	135	136	137
Yield	$\leqslant 1{\cdot}03$	—	$1{\cdot}28$	$< 0{\cdot}0001$	$1{\cdot}000$

These yields are different from those obtained from a smooth extrapolation of the yield curve obtained radiochemically. This is discussed. J. HUGHES

539.172.4

3398. Chemical aspects of atomic energy. J. S. ANDERSON. *Nature, Lond.*, **165**, 134–6 (*Jan.* 28, 1950).

Report on a symposium. Investigations into the place of the transuranic elements in the periodic table established that Np and Pu have no similarity to Re and the Pt metals, but belong to a transition series in which 5*f* rather than 6*d* electron-levels are being filled. Th is the true analogue of Zr and Hf. The constitution of solutions of $UO_2(NO_3)_2$, and their partition equilibria with non-aqueous solvents, are discussed. With each solvent the solubility increases regularly with the O : C ratio, irrespective of the chemical nature of the solvent. The use of physico-chemical methods (e.g. solvent extraction and ion exchange) for isolating fission products in a carrier-free state is outlined. The radiation decomposition of H_2O is an example of a type of reaction in which a primary act of excitation initiates a series of chemical changes. It leads, on long irradiation, to the evolution of H and O and the maintenance of a const. conc. of H_2O_2. The mechanism of this reaction is outlined. J. GRANT

539.172.4

3399. Fast neutron reactions with fluorine and sodium. J. V. JELLEY AND E. B. PAUL. *Proc. Phys. Soc., Lond. A*, **63**, 112–25 (*Feb.*, 1950).

The yields of the (n,p) and (n, α) reactions in F and Na have been measured by observations on the radioactivity produced by bombardment with neutrons from the (d, n) reactions in Li, B, Be and D. Cross-sections have been estimated and methods of deriving the absolute disintegration rates and the neutron flux are described. The reaction energies have also been derived, by assuming a particular form for the excitation function, and using published data on the energy distribution of the neutrons used. A.

539.172.4

3400. Slow neutron-induced activities in europium and samarium. J. M. HILL AND L. R. SHEPHERD. *Proc. Phys. Soc., Lond. A*, 126–36 (*Feb.*, 1950).

The activities produced by n irradiation of Eu and Sm have been investigated by means of a thin lens type β-ray spectrometer and by absorption and coincidence methods. The 9·2 hr activity in Eu is due to the dual decay of Eu^{152} by β^- emission and by K capture. The long period activity is due to both Eu^{152} and Eu^{154}, and again both β^- emission and

K capture are present. This long period K capture is due to Eu^{152}, and the β^- emission is possibly due to both Eu^{152} and Eu^{154}. The energies of the emitted radiations are discussed and possible decay schemes proposed. The 47 hr activity induced in Sm is due to the β^- decay of Sm^{153}, and measurement of the energies of the emitted radiations has been made. A.

539.172.4 : 545

Microchemical methods used in nuclear research. *See Abstr.* 3489

539.172.44 : 539.152.1

3401. Energy of an excited state of Li^7. M. TER-POGOSSIAN, J. E. ROBINSON AND C. H. GODDARD. Letter in *Phys. Rev.*, **76**, 1407–8 (*Nov.* 1, 1949).

An attempt to determine a possible energy difference in the excited states of Li^7 produced in the two processes $B^{10}(n, \alpha)Li^7$, and $Be^7 \rightarrow Li^7$. The Li^7 γ-ray energy in the latter case agreed to within 2 keV with an earlier figure for the former [Abstr. 2121 (1949)].

L. R. SHEPHERD

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.18

3402. A research for anomalous scattering of μ mesons by nucleons. E. AMALDI AND G. FIDECARO. *Helv. Phys. Acta*, **23** (*Nos* 1–2) 93–102 (1950).

Scattering at angles $> 18°$ of μ mesons by an Fe plate 6 cm thick has been investigated by means of a counter-hodoscope which distinguishes two energy bands: one from 180 MeV to 300 MeV, the other from 300 MeV to infinity. In about $2{\cdot}5 \times 10^5$ penetrating particles impinging on the scatterer, 3 scattered particles have been observed in each of the above-mentioned energy bands. An upper limit for the cross-section for anomalous scattering of μ mesons by nucleons is deduced. A.

539.18

3403. On the theory of scattering in a field of central symmetry. O. B. FIRSOV. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 2) 241–4 (1949) *In Russian.*

Mathematical. For fast particles the determination of the scattering-phase leads to an equation which is solved formally using successive approximation methods, not assuming Born's approximation. This is possible provided the potential is effectively constant over the distances considered. For bound particles with negative energy a similar equation is solved for the radial part of the wave function. J. JACOBS

539.18

3404. The decay-probability of mesons. A. Z. DOLGINOV AND S. V. IZMAĬLOV. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 2) 261–3 (1949) *In Russian.*

Theoretical. Formulae are given for the life-time of mesons decaying into 2 or more particles, for various assumptions concerning the spin of the initial particle. E. P. GEORGE

539.18

3405. The excess of negative over positive mesons produced by high energy photons. K. A. BRUECKNER AND M. L. GOLDBERGER. Letter in *Phys. Rev.*, **76**, 1725 (*Dec.* 1, 1949).

Mesons of energy 30–130 MeV produced in C at 90° to the photon beam from the California 330 MeV synchroton show a negative-positive ratio $1{\cdot}7 \pm 0{\cdot}2$ with no significant energy dependence. The classical description of the effect in terms of the current coupling of the photon with meson and nucleon is indicated. The meson contribution is symmetrical, but for the production of negative mesons, a further contribution arises from the recoil proton.

J. G. WILSON

539.18

3406. Production of mesons by X-rays. E. M. MCMILLAN, J. M. PETERSON AND R. S. WHITE. *Science*, **110**, 579–83 (*Dec.* 2, 1949).

The X-rays were produced by the 335 MeV electron synchrotron. Doses of $\sim 1\,000\,r$ impinging on a 1 in dia. C rod produced a density of $\sim$ 100 mesons/cm^2 in adjacent nuclear plates. Absorption measurements show the energy spectrum extends up to 150 MeV, with a max. at 35 MeV. The angular distribution of mesons in the plates shows isotropic distribution at the source. The ratio π^-/π^+ is given as $1{\cdot}7$.

E. P. GEORGE

539.18

3407. On the disintegration products of the 2·2-μsec. meson. E. P. HINCKS AND B. PONTECORVO. *Phys. Rev.*, **77**, 102–20 (*Jan.* 1, 1950).

An investigation of the penetration through absorbers of various elements by the charged particles that result from the 2·2-μsec meson decay is reported. Mesons and decay particles are detected by an arrangement of G.M. counter trays, and delayed coincidence techniques are used to select the desired events. The absorption measurements exhibit 2 components in the decay radiation, one of which is much more penetrating than the other. In Pb, for example, the "soft component" is essentially absorbed by about 20 g/cm^2, while the "hard component" is easily detected after 38 g/cm^2. A different arrangement of counters is used to show that the "hard component" is due to a neutral radiation which accompanies the charged decay particles. This result, and measurements of the intensities of the "hard component" with Pb and C absorbers, provide strong evidence that the neutral radiation is, in fact, bremsstrahlung from the charged particles which constitute the "soft component." The bremsstrahlung intensities, together with the form of the absorption curve, are shown to lead to the following conclusions: (1) the charged decay particles are electrons (i.e. they have a mass < 2 electron masses); (2) a considerable number of electrons are emitted with energies > 25 MeV; (3) the average energy of the electrons is > 25 MeV; (4) there is no evidence for electrons of energy $\geqslant 50$ MeV. The support which these results lend to the currently favoured ideas on the meson decay process is discussed. A.

539.18

3408. Processes involving vector mesons. J. N. SNYDER. Letter in *Phys. Rev.*, **77**, 143 (*Jan.* 1, 1950).

Suggests that interaction may stimulate decay.

539.18

3409. On the nature of the π-meson. B. FERRETTI AND S. GALLONE. Letter in *Phys. Rev.*, **77**, 153–4 (*Jan.* 1, 1950).

Assuming the spin to be zero, experiments to distinguish between scalar and pseudo-scalar mesons are discussed. E. P. GEORGE

539.185

3410. Electromagnetic radiation during proton-neutron collisions. V. YA. FAĬNBERG AND E. L. FEĬNBERG. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 1) 45–7 (1949) *In Russian.*

Such radiation can be clearly separated into magnetic (magnetic moments change) and electric (electric moments change) emission. These correspond to non-interfering different transitions. Different types of forces active during collision are also discussed separately, but some interference may take place. Electric emission is due to exchange of charge only or of charge and spin simultaneously; magnetic emission occurs if exchange either of charge only or of spin only takes place. J. JACOBS

539.185

3411. The distribution of thermal neutrons in the neighbourhood of the edge of a cadmium sheet. D. T. ELBRUS AND K. ZUBER. *Helv. Phys. Acta*, **22** (*No.* 6) 600–3 (1949) *In German.*

Au foils were used to determine the distribution in paraffin near the edge of a Cd sheet. The activity of the Au was measured by the blackening of X-ray film. The results are presented graphically. J. HUGHES

539.185

3412. Experimental arrangement for the measurement of the scattering of slow neutrons from weak sources. C. C. JONKER AND J. BLOK. *Physica*, **15**, 1032–50 (*Dec.*, 1949).

To perform scattering experiments with slow neutrons from Ra–Be sources, a sensitive ionization chamber was constructed filled with natural BF_3; the pressure of the gas was 3 atm.; the efficiency for slow neutrons: 50%. A discussion of the properties of this chamber, the amplifier and the counting circuit is given. It has been possible to adapt the amplifier and the counting circuit so that nearly all pulses caused by slow neutrons are counted. The Fermi-distribution $\cos\theta + \sqrt{3}\,.\cos^2\theta$ was checked with an accuracy of 1·6%. In view of experiments on single and plural scattering of neutrons the influence of the dimensions of the howitzer on the collimation of the beam of slow neutrons was determined. With this howitzer and a special constructed collimator a collimation with a mean divergence of 5° was obtained. A.

539.185

3413. Neutron-proton scattering. H. N. YADAV. Letter in *Phys. Rev.*, **76**, 1720–1 (*Dec.* 1, 1949).

The total cross-section for *n–p* scattering at 90 MeV was calculated using a Yukawa potential well interaction with ranges 0·80 and $1{\cdot}60\times10^{-13}$ cm for the central and tensor forces respectively for the triplet interaction, and $1{\cdot}18\times10^{-13}$ cm for the singlet interaction. In the range 0–3 MeV, the calculated cross-section agrees with the experimental results. The high energy (83 MeV) cross-sections are too large, 14·6 and $12{\cdot}1\times10^{-26}$ cm² for the symmetrical and Serber type interactions respectively. The Born approximation gives a much smaller value than the exact method. J. HUGHES

539.185

3414. Functions used in Flügge's method of predicting approximate spatial neutron distributions. L. SECREST. Letter in *Phys. Rev.*, **77**, 141–2 (*Jan.* 1, 1950).

539.185 : 539.164 : 541.141

The action of neutrons on benzene. *See Abstr.* 3465

STRUCTURE OF SOLIDS 539.2

539.215.2

3415. Theory of growth of spherical precipitates from solid solution. C. ZENER. *J. Appl. Phys.*, **20**, 950–2 (*Oct.*, 1949).

The radius of a spherical precipitate particle growing in a solid solution of initially uniform composition may be shown to be equal to $\alpha(Dt)^{\frac{1}{2}}$, where D is the atomic diffusion coeff., t the time of growth, and α, the growth coeff., is a dimensionless function of the pertinent compositions. The precise dependence is found of this function upon the pertinent concentrations. A similar computation is made for the growth coeff. corresponding to the one-dimensional growth of a plate. A.

539.215.2

3416. Effect of small quantities of hydrogen and grain size on the α–β transformation of titanium. A. D. MCQUILLAN. Letter in *Nature, Lond.*, **164**, 537 (*Sept.* 24, 1949).

The double transformation reported to occur in fine grain Ti containing 0·02 atomic % H [Abstr. 5394 (1949)] merges into a single transformation at 882 ± 3°C for H-free metal and coarse-grained metal containing 0·02 atomic % H. H. P. MYERS

539.215.2

3417. Precipitation from solid solutions of C and N in α-iron. C. A. WERT. *J. Appl. Phys.*, **20**, 943–9 (*Oct.*, 1949).

The formation of precipitates from the solid solutions of C and N in α-iron has been studied by means of the internal friction peak associated with the stress-induced interstitial diffusion of the solute atoms. A transformation law has been found to fit the experimental data. The data are interpreted as showing the following: (1) Fe_3C precipitates in the shape of spheres; (2) an intermediate phase in the precipitation of N forms in the shape of discs; and (3) within the experimental error there is indicated no continuous nucleation. A.

539.215.2

3418. The effect of thermal cycles on the structure of alloys: diffusion effects in two phase alloys. R. J. DAVIS AND W. HUME-ROTHERY. *Proc. Roy. Soc. A*, **200**, 441–58 (*Feb.* 22, 1950).

539.215.6

3419. Activation energy for copper self-diffusion. J. H. HOLLOMON. **Reply to "Activation energy for copper self-diffusion."** J. H. DEDRICK AND A. GERDS. Letters in *J. Appl. Phys.*, **21**, 261 (*March*, 1950).

See Abstr. 2026 (1950).

539.217

3420. Interstitial atomic diffusion coefficients. C. WERT AND C. ZENER. *Phys. Rev.*, **76**, 1169–75 (*Oct.* 15, 1949).

An attempt is made to interpret the temp.-independent factor D_0 of the previously determined diffusion coeff., of interstitial solute atoms in metals. The primary uncertainty in the value of D_0 given by the standard reaction rate theory resides in an entropy factor $\exp(\Delta S/R)$. When cognizance is taken of an additional strain in the lattice surrounding a solute atom as it passes over a potential energy divide and of the increase in entropy associated with an increase in lattice strain energy, one can estimate a "theoretical" range within which these entropy factors should lie. All past observations except for C and N in α–Fe are consistent with this theoretical range. The D_0's for these two systems were, therefore, redetermined by more precise measurements, and are found to be an order of magnitude > the original values. The associated entropy factors are consistent with the theoretical range. A.

539.217

3421. Diffusion in binary alloys. J. BARDEEN. *Phys. Rev.*, **76**, 1403–5 (*Nov.*, 1949).

Darken [*Metals Tech., Tech. Paper* 2311 (1948)] has given a phenomenological theory of diffusion in binary alloys based on the assumption that each constituent diffuses independently relative to a fixed reference frame. It is shown that diffusion via vacant lattice sites leads to Darken's equations if it is assumed that the concentration of vacant sites is in thermal equilibrium. Grain boundaries and dislocations may act as sources and sinks for vacant sites and act to maintain equilibrium. The modifications required in the equations if the vacant sites are not in equilibrium are discussed. A.

539.217

3422. Energy for diffusion by direct interchange. H. B. HUNTINGTON AND F. SEITZ. Letter in *Phys. Rev.*, **76**, 1728 (*Dec.* 1, 1949).

The value for the electrostatic energy associated with the saddle-point configuration for direct-interchange diffusion in Cu given as 11 eV in a previous paper [Abstr. 1882 (1942)] has been recalculated as 4·8 eV. The energy of this configuration associated with closed shell repulsion of ion cores has also been recalculated, using recent high pressure data. The value obtained is 5·5 eV (cf. the previous value of 6·2 eV). The results indicate that direct interchange is ruled out for the self-diffusion of Cu.

E. P. WOHLFARTH

539.217

3423. Rate of self-diffusion in tin crystals. W. BOAS AND P. J. FENSHAM. Letter in *Nature, Lond.*, **164**, 1127–8 (*Dec.* 31, 1949).

The rate of diffusion in white Sn has been measured using a thin layer of radio-active tracer Sn^{113}, making measurements over 1–2 days with the Sn at a constant temp. in the range 180–225°c. The diffusion coeff. D depends on the direction in the tetragonal crystal, the ratio D_c/D_a being about 2 at 180°c and about 3 at 223°c. On extrapolating the linear curves of $\log D_c$ *v.* $1/T$ and $\log D_a$ *v.* $1/T$ it is found that D_a and D_c become equal at 125°c and below this $D_a > D_c$. The significance of the results is discussed. C. A. HOGARTH

539.217 : 539.388.2

3424. The equilibrium swelling of cross-linked amorphous polymers. L. R. G. TRELOAR. *Proc. Roy. Soc. A*, **200**, 176–83 (*Jan.* 6, 1950).

The degree of swelling of an amorphous linear polymer in a low-molecular liquid is determined by the free-energy change associated with the process of mixing of polymer and liquid molecules. In the swelling of a cross-linked polymer an additional free-energy change, arising from the elastic extension of the 3-dimensional molecular network, has to be taken into account. This term is dependent not only on the volume of the swollen gel, but also on its state of strain; its magnitude may be calculated from the statistical network theory. The way in which this affects the equilibrium swelling is considered, and particular cases of swelling in the presence of external restraints are discussed. In the case of a tensile stress, both theory and experiment show that the equilibrium concentration of liquid is higher than in the unstrained polymer. A.

539.217.3

3425. Permeability of pectinate films to water vapour. T. H. SCHULTZ, J. C. MIERS, H. S. OWENS AND W. D. MACLAY. *J. Phys. Coll. Chem.*, **53**, 1320–30 (*Dec.*, 1949).

539.219.1

3426. Distribution of phases in two-phase solids. L. D. JAFFE. *J. Appl. Phys.*, **20**, 1206–8 (*Dec.*, 1949).

The quasi-equilibrium distribution of a dispersed phase, *B*, within a polycrystalline second phase, *A*, is investigated by methods of statistical thermodynamics. Phase *B* is assumed to consist of spherical particles of uniform size within the *A* crystals, and of lenticular particles of uniform size at the boundaries between two *A* crystals. The relation of the concentration of *B* at the grain boundaries of *A* to the sizes of the *B* particles at and away from grain boundaries is found, in terms of the interfacial energies, the temperature, the over-all concentration, and the size of the *A* crystals. A.

539.22 : 538.114 : 530.162

Order-disorder statistics. *See Abstr.* 2929

539.23

3427. An investigation by electron microscope into the structure of Pt films formed on the surface of aqueous solutions of the metal salt by reducing gases. N. N. BUINOV, N. V. DEMENEV, A. S. SHUR AND G. G. FEDOROVA. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 2) 223–6 (1949) *In Russian.*

539.23

3428. International colloquium on solid thin films. P. JACQUINOT AND P. ROUARD. Letter in *J. Opt. Soc. Amer.*, **39**, 1048–50 (*Dec.*, 1949).

Report on a colloquium held at Marseille, April 19–23, 1949.

539.264

3429. On some stacking disorders in the layer structures of clay minerals. M. NAKAHIRA AND S. IWAI. *J. Sci. Res. Inst., Tokyo*, **44**, 79–86 (*Dec.*, 1949).

539.264 : 547.833

3430. An X-ray camera for obtaining powder pictures at high pressures. A. W. LAWSON AND N. A. RILEY. *Rev. Sci. Instrum.*, **20**, 763–5 (*Nov.*, 1949).

Two methods are described which have been successfully employed to identify simple high pressure structures at pressures ranging up to 15 000 atmos. The essential feature common to both schemes is to encase the sample in a small Be bomb which serves to retain the pressure but permits the X-rays to be transmitted to the sample and diffracted to an external recording film. Sample data on Ce are given to illustrate the possibilities and limitations of this technique. A.

539.266

3431. A test of the interpretation of X-ray patterns of micelles. J. T. DAVIES AND W. PHILLIPOFF. Letter in *Nature, Lond.*, **164**, 1087 (*Dec.* 24, 1949).

X-ray diffraction patterns were obtained from double layers of Pb stearate deposited on polished Cr. A single double layer gave a pattern comparable with the "*M*-band" observed in diffraction from soap solutions and attributed to double layers [*J. Chem. Phys.*, **16**, 644 (1948)]; several (up to 25) double layers gave patterns comparable with those attributed to micelles. The lines in the pattern corresponded directly with the powder pattern of solid Pb stearate. The correction factor 1·23 proposed on analogy with diffraction by fluids is therefore unnecessary.

A. J. C. WILSON

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.32 : 541.64

3432. Comments on creep and damping properties of polystyrene. W. N. FINDLEY. Letter in *J. Appl. Phys.*, **21**, 258–60 (*March*, 1950).

See Abstr. 5699 (1949).

539.32 : 548.0

Elastic constants of lithium fluoride. *See Abstr.* 3495

539.37

3433. Measurements of mechanical properties of polyisobutylene at audiofrequencies by a twin transducer. R. S. MARVIN, E. R. FITZGERALD AND J. D. FERRY. *J. Appl. Phys.*, **21**, 197–203 (*March*, 1950).

Apparatus has been developed for measuring the dynamic viscosity and rigidity of soft rubber-like solids in small oscillating deformations. A plate rigidly attached between two identical coils in two permanent magnets shears a pair of disc-shaped samples when a driving current is passed through one coil. The open-circuit voltage from the other coil is compared in amplitude and phase with the driving current by a method in which all measurements are in the form of settings of a potential divider. The apparatus has two advantages: (*a*) the amplitudes of motion are extremely small, thus minimizing any non-linear effects, or temperature change due to heat dissipation; (*b*) a continuous range of frequencies is available without adjusting masses. The dynamic rigidity and viscosity of two samples of polyisobutylene, of mol. wts. 1·2 and 0·47 million, have been measured at 15, 25 and 35°c at frequencies from 20 to 600 c/s. The rigidity increases and the viscosity decreases with increasing frequency. Both decrease with increasing temperature, and are almost independent of mol. wt. The temperature-dependence is quantitatively explained by the assumption that stresses relax by flow processes whose apparent activation energies are all identical with that characterizing the steady flow viscosity. A.

539.374

3434. Complex stressing of polyethylene. I. L. HOPKINS, W. O. BAKER AND J. B. HOWARD. *J. Appl. Phys.*, **21**, 206–13 (*March*, 1950).

Polyethylene of such molecular weight and structure that it readily fibres or cold draws to 300–600% elongation by usual uniaxial, tensile stressing may react quite differently under biaxial tension. When biaxial tension in 1 : 1 ratio is applied to a diaphragm, some polymers show brittle fracture with $< 20\%$ elongation at break. However, if the average mol. wt. is shifted upward the polymers orient under complex stresses. Then, they usually elongate several hundred % before rupture. Variations in crystallinity are also significant. X-ray scattering of stressed samples suggests that preferred glide on certain crystallite planes tends to occur as the yield point approaches. These are such as to inhibit smooth alignment of the long chain axis in the direction of stressing. This could lead to brittleness. Apparatus for complex stressing of sheets and tubes is described. Strains are taken from coordinates printed on the sample by the silk screen process. High speed stressing was also observed. The speed of retraction of amorphous polyethylene chains approaches that of rubber. A.

539.374

3435. On the inhomogeneity of plastic deformation in metals. W. BOAS. *Helv. Phys. Acta*, **23** (*No.* 1–2) 159–66 (1950).

Microscopic inhomogeneity of plastic deformation in metals and alloys due to crystal anisotropy and the presence of crystals of different structures is described. The importance of the inhomogeneity in relation to the theory of the deformation of crystal aggregates is discussed. It is shown that macroscopic inhomogeneity is produced by common methods of deformation. A.

539.375

3436. A proposal of a new theory concerning the yielding of materials based on Riemannian geometry. I. K. KONDO. *J. Soc. Appl. Mech. Japan*, **2** (*No.* 11) 123–8 (1949).

The sharp yielding of a metal such as mild steel is regarded as an instability phenomenon, analogous to the buckling of a flat plate, under compression in its own plane, into a third dimension. A test-piece which is stressed beyond the yield point ceases to possess a stress-free equilibrium configuration in the

ordinary Euclidean space of 3 dimensions, to which it can return when external forces are removed. But such a body with residual stresses is supposed to possess a stress-free configuration in a curved Riemannian 3-dimensional space, embedded in Euclidean space of 6 dimensions. J. G. OLDROYD

539.38 : 536.763

3437. Effects of stress and deformation on the martensite transformation. A. W. McREYNOLDS. *J. Appl. Phys.*, **20**, 896–907 (*Oct.*, 1949).

539.4.01

3438. The Rehbinder effect. E. N. DA C. ANDRADE AND R. F. Y. RANDALL. Letter in *Nature, Lond.*, **164**, 1127 (*Dec.* 31, 1949).

Rehbinder and his colleagues found that surface active agents (liquids) brought into contact with the surface of metals, especially single crystals, markedly decreased the mechanical strength [*Dokl. Akad. Nauk, SSSR*, **32**, 130 (1941)]. The authors consider that the action of the surface-active liquid might be to disintegrate the very thin surface oxide film which increases the mechanical strength of the metal. Single crystals of Cd, which had been treated in various ways, were tested with a 0·2% solution of oleic acid in non-polar paraffin. Results indicate that the Rehbinder effect is due to the action of the surface oxide layer and not to a penetration of the liquid through imperfections in the metal surface as previously suggested. The reaction takes some tens of minutes to establish an effect, that of the slowly and naturally formed oxide layer being more marked than that of one quickly and deliberately produced. C. A. HOGARTH

539.4.014

3439. X-ray diffraction line broadening and strain hardening. D. ROSENTHAL. Letter in *J. Appl. Phys.*, **20**, 1257 (*Dec.*, 1949).

An experiment with mild steel suggests that the broadening of lines is indicative of the heterogeneity of strain hardening rather than strain hardening itself. H. P. MYERS

539.4.016

3440. Some implications of work hardening and ideal plasticity. D. C. DRUCKER. *Quart. Appl. Math.*, **7**, 411–18 (*Jan.*, 1950).

The mathematical theory of work hardening and ideal plasticity is discussed and the severe restriction imposed by this on possible stress-strain relations is pointed out. Prager's extension [Abstr. 2759 (1949)] of the Mises plastic potential function is further extended. The meaning of stability of plastic deformation is discussed. L. S. GODDARD

539.411

3441. Elasticity and rupture of concrete and stone at constant rates of loading. R. JONES. Letter in *Nature, Lond.*, **165**, 39–40 (*Jan.* 7, 1950).

The velocity of an ultrasonic pulse through concrete and stone cubes of 4 in side was measured at intervals while the cubes were loaded to failure in compression. With increasing load, the velocity of the pulse in the concrete cubes parallel to the direction of loading remained constant, indicating that the elastic modulus did not vary. In the transverse direction, the velocity began to decrease when the applied load was about 30% of that causing failure. This decrease was attributed to internal cracking and depended on the age and type of concrete but was independent of the rate of loading within the range 600–5 000 lb/sq in/min. When basalt stone cubes were tested, the velocity of the pulse parallel to the direction of loading remained constant to beyond the start of internal rupture, while the transverse velocity remained constant nearly up to failure of the cube. With York stone the velocity in the direction of loading increased with load and this was attributed to the closing of the voids. A. C. WHIFFIN

539.4

3442. Study of crack propagation using high speed motion pictures. H. I. FUSFELD AND J. C. FEDER. Letter in *J. Appl. Phys.*, **21**, 261–2 (*March*, 1950).

539.501

3443. On the formulation of rheological equations of state. J. G. OLDROYD. *Proc. Roy. Soc. A*, **200**, 523–41 (*Feb.* 22, 1950).

The invariant forms of rheological equations of state for a homogeneous continuum, suitable for application to all conditions of motion and stress, are discussed. The right invariance properties can most readily be recognized if the frame of reference is a co-ordinate system convected with the material, but it is necessary to transform to a fixed frame of reference in order to solve the equations of state simultaneously with the equations of continuity and of motion. An illustration is given of the process of formulating equations of state suitable for universal application, based on non-invariant equations obtained from a simple experiment or structural theory. Anisotropic materials, and materials whose properties depend on previous rheological history, are included within the scope of the paper. A.

539.61

3444. Friction and adhesion of clean metals. F. P. BOWDEN AND J. E. YOUNG. Letter in *Nature, Lond.*, **164**, 1089–90 (*Dec.* 24, 1949).

539.62

3445. The temperature of surface friction of solids (theoretical error in Bowden's work). M. P. LEVTSKIĬ. *J. Tech. Phys., USSR*, **19**, 1010–14 (*Sept.*, 1949) *In Russian.*

The paper criticized is by F. P. Bowden and K. E. Ridler [*Proc. Roy. Soc. A*, **154**, 640 (1936)]. It is shown that the generally accepted result of a linear relation between temp. and friction or relative velocity of sliding is wrong and due to a too elementary and, moreover, unfinished derivation by Bowden. The experimental part of Bowden's investigation was partly carried out. The rectified relation has the form $T = f(\sqrt{v})$ and could be verified in all experiments on cutting of metals. B. F. KRAUS

539.67

3446. Elastic properties of metals drawn into wires. Viscosities of metals. C. SALCEANU; P. LE ROLLAND. *Ann. Franç. Chronom.*, **3** (*No.* 4) 387–408 (1949) *In French.*

The wires (of Fe, Ni, steel, Cu, brass, Ag and Al) 0·5 mm dia. and 1·2 m long were fixed to a wall at one end and stretched horizontally over a pulley 1 m from the wall, and held in tension by weights.

Two pendulums 19 cm apart were fixed to the wires symmetrically about the mid-pt., and the time interval between their min. amplitudes when oscillating in resonance was noted. The relations between periods of pendulums supported in this way was examined mathematically, and it was shown that the modulus of rigidity of the metal of the wire could be derived. By passing an electric current through the supporting wire it is easy to determine elastic properties of the metals when submitted to thermal treatment under any desired tension. The metals were also studied by noting the period of oscillation of a torsional pendulum (of the wire concerned under controllable tension) using an electrical timing mechanism accurate to + 0·000333 sec. The time of oscillation was found to decrease with increasing load until it reached a level attributed to the elastic homogeneity of the metal. The viscosities of Al, Fe, steel, Pb, Ag, Ni, Cu, Pt and W were determined by a new method based on the damping of the oscillations of a torsional pendulum, and it was found that heating increased the coeff. of viscosity of metals. The values found for η ($t = 21°$C) were: Al $6{\cdot}1\times10^8$; Fe $21{\cdot}2\times10^8$, steel $21{\cdot}9\times10^8$; Pb $25{\cdot}7\times10^8$; Ag $50{\cdot}6\times10^8$; Ni 64×10^8; Cu 106×10^8; Pt $111{\cdot}3\times10^8$; W 481×10^8, these values being rather higher than those found by previous workers using other methods. W. ASHWORTH

539.67

3447. An apparatus for measurement of extremely high internal friction. T'ING-SUI KÊ AND M. ROSS. *Rev. Sci. Instrum.*, **20**, 795–9 (*Nov.*, 1949).

A simple torsion apparatus has been developed for measurement of extremely high internal friction by determining the angle by which strain lags behind the stress in forced cyclic vibration. The results of measurement were compared with torsion pendulum measurements using free decay method. The highest internal friction measured with this apparatus was 0·55. This apparatus can be used to measure internal friction at a constant given stress amplitude and at a constant frequency of vibration. The stress amplitude and frequency of vibration can easily be varied over a wide range. There is no theoretical limit to the lowest frequency of vibration that can be used with this apparatus. The feature that measurements can be made while the zero point is changing renders this apparatus very useful in the study of internal friction of freshly cold-worked metals. A.

539.67

3448. On the determination of the energy dissipated by internal friction. P. SORIN. *C.R. Acad. Sci., Paris*, **229**, 1123–4 (*Nov.* 28, 1949) *In French.*

A direct method of measuring the energy dissipated, using Le Rolland's method of coupling the test-piece between two identical oscillating systems, is described. It is only necessary to measure the energy which must be given to one of the oscillators to cause it to come to rest after half the time between successive beats. J. G. OLDROYD

539.67

3449. The measurement of the coefficient of internal friction of solid rods by a resonance method. W. LETHERSICH AND H. PELZER. *Brit. J. Appl. Phys.*, **1**, 18–22 (*Jan.*, 1950).

A theory is given and an expression derived relating amplitude of vibration with frequency for a rod subjected to alternating mechanical stress. The coeff. of internal friction of the material can be deduced providing the internal friction is small as, for example, with metals. With plastics the internal friction is larger, so that a correction must be applied which can be expressed in the form $\eta/E = (\delta f/2\pi f^2)(1 + 2\delta f/f)$. The physical basis from which the fundamental equations are derived is discussed and the relation between longitudinal and tangential viscosity is deduced. An expression has also been derived which enables the volume viscosity to be determined should experiments show its existence. A.

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM CHEMICAL REACTIONS 541.11/.12

541.124

3450. An excursion in chemical thermodynamics. F. D. ROSSINI. *J. Wash: Acad. Sci.*, **39**, 249–69 (*Aug.*, 1949).

An address. W. R. ANGUS

541.124 : 533.6.011.5

3451. Sudden changes of compression produced at non-equilibrium chemical transformations in a supersonic gas stream. I. I. NOVIKOV. *J. Tech. Phys., USSR*, **19**, 1053–5 (*Sept.*, 1949) *In Russian.*

By solving the quadratic equation for a flat supersonic gas stream in which a non-equilibrium chemical change takes place, two solutions for $\lambda_2(= w_2/a_2)$ are obtained for each value of $\varepsilon > \varepsilon' = 2\lambda_1/(1 + \lambda_1^2)$ (where $\lambda_1 = w_1/a_1$, w_1 and w_2 are gas speeds, and a_1 and a_2 the so-called critical speeds before and after the sudden change, respectively). Solutions > 1 lie on the upper branch of the curve, while those < 1 lie on its lower branch. The lower branch corresponds to sudden changes of compression of the usual type, i.e. with subsonic post-change speed. One part of the upper curve corresponds to sudden changes of rarefaction, the other part to sudden changes of compression characterized by supersonic post-change speed. The latter compression changes differ strongly from the ordinary ones by having local character only; they are thermodynamically possible. F. LACHMAN

541.126

3452. The dynamics of the combustion products behind plane and spherical detonation fronts in explosives. G. TAYLOR. *Proc. Roy. Soc. A*, **200**, 235–47 (*Jan.* 6, 1950).

The flow behind the detonation front of an

explosive contained in a tube strong enough to confine the motion to 1 dimension is shown to be a progressive wave of finite amplitude of the type studied by Riemann. The wave is similar at all stages of its progress if the initiation of the explosion is instantaneous, the linear scale of the whole field of flow increasing at a uniform rate. If the products of combustion obey the law $p\rho^{-\gamma} =$ constant the distribution of gas velocity along the tube is linear. If the initiation end of the tube is closed a fixed proportion of the whole detonating column is at rest. This last case has an analogy in 3 dimensions. The dynamics of spherical detonation from a point in an explosive is analysed. As in the 1-dimensional case, a fixed proportion of the whole volume of burnt gas is at rest. The radial rate of change of the variables, velocity, pressure and density become infinite at the detonation front, but it is unlikely that this result would be true in a real explosive where the time of reaction is not zero. The results are applied in both linear and spherical cases to the detonation of T.N.T.

A.

541.127

3453. Carbon isotope effect on reaction rates. K. S. PITZER. Letter in *J. Chem. Phys.*, **17**, 1341–2 (*Dec.*, 1949).

541.127

3454. Reactivity of different faces of a copper single crystal. P. R. ROWLAND. Letter in *Nature, Lond.*, **164**, 1091–2 (*Dec.* 24, 1949).

541.128

3455. Use of O^{18} as indicator in heterogeneous catalysis. S. M. KARPACHEVA AND A. M. ROSEN. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 6) 1057–60 (1949) *In Russian.*

541.128

3456. (About the) influence of the walls of vessels on chemical reactions. M. V. POLYAKOV. *Dokl. Akad. Nauk, SSSR*, 69 (*No.* 2) 217–18 (1949) *In Russian.*

It has been found that the values of optimum temperature and duration of contact action for the oxidation of NH_3 to NO in the presence of Pt do not result from a single catalytic process in which Pt plays a part; this process is preceded by a homogeneous-heterogeneous reaction in which the walls of the tube take part. This reaction leads to defixation of N and to lowering of the NO yield.

F. LACHMAN

541.128

3457. On the catalyst surface structure. S.-C. LIANG. Letter in *J. Chem. Phys.*, **17**, 1348–9 (*Dec.*, 1949).

ELECTROCHEMISTRY 541.13

541.135.5

3458. Electrochemical thermodynamics and kinetics of hydrogen overvoltage. P. VAN RYSSELBERGHE. *J. Chem. Phys.*, **17**, 1226–31 (*Dec.*, 1949).

PHOTOCHEMISTRY RADIATION CHEMISTRY 541.14

541.1

3459. Polymerization by γ-rays (II). A. CHAPIRO. *C.R. Acad. Sci., Paris*, **229**, 827–9 (*Oct.* 24, 1949) *In French.*

See Abstr. 7363 (1949).

541.1

3460. The effects of radioactivity on oleic acid. V. L. BURTON. *J. Amer. Chem. Soc.*, **71**, 4117–1 (*Dec.*, 1949).

541.1

3461. The sodium (^2P) photo-sensitized decomposition of ethane. G. L. LEE AND D. J. LEROY. Letter in *J. Chem. Phys.*, **17**, 1349–50 (*Dec.*, 1949).

541.14 : 538.22

3462. Photo-chemical reduction of water by europium (*II*) ion, and the magnetic susceptibilities of europium (*II*) and (*III*) ions. D. L. DOUGLAS AND D. M. YOST. Letter in *J. Chem. Phys.*, **17**, 1345–6 (*Dec.*, 1949).

541.14

3463. Chemical actions of ionising radiations on aqueous solutions. I. Introductory remarks and description of irradiation arrangements. F. T. FARMER, G. STEIN AND J. WEISS. *J. Chem. Soc.*, 3241–5 (*Dec.*, 1949).

The development of the theory of the action of ionizing radiations on aqueous solutions, leading up to the theory of formation of free radicals, is discussed. Apart from the intrinsic interest in the action of the radiations, these investigations are of interest because they allow the reactions of free radicals to be studied in the absence of interfering reagents and because the products of reaction are somewhat similar to those obtained in biological systems in which the same molecules are involved. Experimental arrangements for irradiations with (i) X-rays (γ-rays), (ii) neutrons, and (iii) α-rays, used in the following investigations and the radiation dosimetry, are discussed in detail.

A.

541.141 : 537.531

3464. Chemical actions of ionising radiations on aqueous solutions. II. The formation of free radicals. The action of X-rays on benzene and benzoic acid. G. STEIN AND J. WEISS. *J. Chem. Soc.*, 3245–54 (*Dec.*, 1949).

The action of X-rays on dilute aqueous solutions of benzene has been investigated qualitatively and quantitatively under various conditions. Phenol and diphenyl have been isolated from solutions irradiated in the absence of O, and the amount of H evolved has been determined. The reaction has also been studied in the presence of O and in H. From solutions of benzoic acid (irradiated in the absence of O) *o*- and *p*-hydroxybenzoic acid have been isolated. The formation of these products, and the detailed quantitative investigation of the reaction (particularly for benzene), have confirmed the theory of indirect action of ionizing radiations, involving the formation of OH radicals and H atoms, and have led to a partial elucidation of the reaction mechanism.

A.

541.141 : 539.164 : 539.185

3465. Chemical actions of ionizing radiations on aqueous solutions. III. The action of neutrons and of α-particles on benzene. G. Stein and J. Weiss. *J. Chem. Soc.*, 3254–6 (*Dec.*, 1949).

In addition to the products (phenol, diphenyl) obtained by irradiation with X-rays, polyphenols and, in particular, an aliphatic dialdehyde, resulting from the opening of the benzene ring, have been isolated. The formation of these products in the case of the densely ionizing radiations appears to be the result of multiple interactions on the same molecule, caused by the high local concentration of the radicals. A sensitive colour reaction of the dialdehyde can be used to indicate the action of these densely ionizing radiations. A.

541.141 : 537.531

3466. Chemical actions of ionising radiations on aqueous solutions. IV. The action of X-rays on some amino-acids. G. Stein and J. Weiss. *J. Chem. Soc.*, 3256–64 (*Dec.*, 1949).

The action of X-rays on glycine, alanine and serine in aqueous solutions has been studied under different conditions, e.g. in the presence of O (air), in a vacuum, in H, at different *p*H values, at different concentrations, etc. It has been found that a deamination occurs and that NH_3 and other products are formed. From the latter the corresponding aldehydes have been isolated as their 2 : 4-dinitrophenylhydrazones. The amounts of the ammonia, aldehydes and molecular H formed in the reaction were shown to be a non-linear function of the dose. A number of features of the mechanism of deamination has been discussed and it is concluded that, in general, an oxidative and a reductive mechanism are operative in the deamination of amino-acids. In particular, when X-rays act on aqueous solutions, producing OH radicals and H atoms, both radicals are presumably capable of initiating deamination. A.

DISPERSIONS . COLLOIDS . ADSORPTION 541.18

541.182.2 : 535.343.4

3467. Use of water sprays to improve light transmission through oil smoke. J. H. Burgoyne and D. J. Rasbash. *Fuel*, **28**, 281–5 (*Dec.*, 1949).

The results of an investigation into the effectiveness of water sprays as a means of dispersing smoke in fire fighting are presented. For paraffin oil smokes, the efficiency increased for finer spray and the addition of wetting agents never produced a sufficient improvement to be of practical significance. J. M. Hough

541.183.25

3468. The properties of freshly formed surfaces. XI. Factors influencing surface activity and adsorption rates in aqueous decyl alcohol solutions. C. C. Addison and S. K. Hutchinson. *J. Chem. Soc.*, 3387–95 (*Dec.*, 1949).

541.183.25

3469. The properties of freshly formed surfaces. XII. An experimental study of the desorption process with particular reference to aqueous decyl alcohol solutions. C. C. Addison and S. K. Hutchinson. *J. Chem. Soc.*, 3395–403 (*Dec.*, 1949).

541.183.25

3470. The properties of freshly formed surfaces. XIII. The compressibility of soluble films of decyl and other alcohols. C. C. Addison and S. K. Hutchinson. *J. Chem. Soc.*, 3404–6 (*Dec.*, 1949).

541.183.25

3471. The properties of freshly formed surfaces. XIV. Further studies of the influence of surface expansion on soluble films of long-chain compounds. C. C. Addison and S. K. Hutchinson. *J. Chem. Soc.*, 3406–11 (*Dec.*, 1949).

541.182.3

3472. A new dust-feed mechanism. B. M. Wright. *J. Sci. Instrum.*, **27**, 12–15 (*Jan.*, 1950).

The history of previous attempts to generate artificial dust clouds is reviewed and the technical difficulties are analysed. A new method is described, in which the dust is packed into a cake, of which the surface is then scraped off in a very thin layer into an air stream. Details are given of the construction and performance of a new mechanism based on this principle. Concentrations can be indefinitely kept constant within a range of ± 20% and the mechanism is suitable for a large variety of fine dusts. A.

541.182.5

3473. Adsorption properties and structure of silica gels and alumina gels. M. M. Dubinin and A. G. Zuev. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 2) 209–12 (1949) *In Russian.*

Isotherms of sorption and desorption of benzene vapours have been measured at 20° for 8 samples of silica gels and 5 samples of alumina gels; the vacuum method of sorption weights was used. (Three diagrams and two tables.) F. LACHMAN

541.183

3474. The phenomenon of the irreversible hysteresis of the sorption isothermals of water on porous glass and silica gel. S. P. Zhdanov. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 1) 99–102 (1949) *In Russian.*

541.183

3475. On the interaction of colloidal particles. III. Some theorems concerning the free energy of double layers. S. Levine. *Phil. Mag.*, **41**, 53–65 (*Jan.*, 1950).

Making use of the Poisson–Boltzmann equation, a number of theorems relating to the free energy of the electric double layers of colloidal particles in dilute sols is developed. A general proof is given for the equivalence of two methods for determining this free energy, viz. by (i) using the fictitious process of charging the excess ions in the double layers subject to the condition of constant surface density of ions and (ii) imagining that the particles are charged by bringing ions from the interior of the dispersion medium to the surface. In the case of two infinite parallel plates, the difficulty that arises due to the infinity of the surface potential, when all the ions are supposed completely discharged, is satisfactorily explained. A.

541.183.2

3476. Thermodynamics of adsorption from solution. II. Free energy changes and surface pressure-area relationships of adsorbed layers. YING FU, R. S. HANSEN AND F. E. BARTELL. *J. Phys. Coll. Chem.*, **53**, 1141–51 (*Nov.*, 1949).

The interpretation of measured values for adsorption from binary liquid solution in terms of surface excesses necessary for calculation of thermodynamic quantities has been presented. From the surface excesses thus obtained free energy decreases due to adsorption have been calculated and derived force–area, force–surface excess, and force–area *v.* force curves have been plotted. The forms of these curves provide additional evidence for the multilayer adsorption of various solutes from aqueous solution by graphites and carbon blacks. A.

541.183.2

3477. Permanent hysteresis in physical adsorption. S. M. KATZ. *J. Phys. Coll. Chem.*, **53**, 1166–86 (*Nov.*, 1949).

Self-consistency rules for the adsorption–desorption scanning behaviour of hysteretic systems have been developed on the basis of both the open-pore theory and the ink-bottle theory of adsorption hysteresis in rigid non-swelling systems. The application of these self-consistency rules to existing hysteresis data indicates that neither theory is valid. Taking into consideration the possibility of experimental error, however, it is shown that the ink-bottle mechanism is confirmed. A consideration of the shapes of the scanning curves shows that the open-pore model, by itself, cannot explain hysteresis, while a determination of pore-size distributions based on the ink-bottle theory yields results compatible with those expected from statistical considerations. A method of predicting adsorption scanning behaviour is developed and found to agree with experimental data. A.

541.183.25

3478. The adsorption of fatty acids on carbon blacks. Calculation of particle size. H. A. SMITH AND R. B. HURLEY. *J. Phys. Coll. Chem.*, **53**, 1409–16 (*Dec.*, 1949).

A study has been made of the adsorption of fatty acids on C blacks. It was found that when acetic acid was adsorbed using cyclohexane as the solvent, the isotherm indicated that a unimolecular layer was readily formed on the C surface. Surface areas calculated on the assumption that the cross-section of the acid molecule in the adsorbed layer is 20·5 sq Å are, in general, in agreement with the areas calculated by other methods. A.

541.183.26

3479. The adsorption of nitrogen, argon, and oxygen on potassium chloride at 78–90°K. A. G. KEENAN AND J. M. HOLMES. *J. Phys. Coll. Chem.*, **53**, 1309–19 (*Dec.*, 1949).

The adsorptions, for KCl with a specific surface of about 3 m^2/g, have been measured at various temperatures from 78° to 90°K and at pressures from 15 to 850 mm. Values of the correction factor required to take into account the gas imperfections at these low temperatures were also determined experimentally. The specific surface of the adsorbent h[a]s been calculated by both the B.E.T. and the Harkin[s] Jura methods, and the cross-sectional areas of t[he] adsorbate molecules required to bring about agre[e]ment are reported. The slopes of the N isotherm[s] show a sharp increase at the relative pressures which the corresponding Harkins–Jura plots indica[te] a phase change. It is suggested that this may be [an] indication of the initiation of adsorption into laye[rs] above the first.

CHEMICAL STRUCTURE 541.4/.6

541.[2]

3480. Some applications of the valence-bond metho[d] to problems of molecular structure. III. Calculation of the lengths of bonds in molecules which contain [a] polyvalent central atom. J. SCANLAN AND E. WA[L]HURST. *Trans. Faraday Soc.*, **45**, 1000–21 (*Nov.* 1949).

541.[2]

3481. The nature of the sulphur-oxygen bon[d] W. MOFFITT. *Proc. Roy. Soc. A*, **200**, 409–28 (*Feb.* 1950).

The electronic structures of certain molecules con[-]taining O–S bonds are analysed in some detail b[y] means of the molecular orbital method. It is possib[le] to make rough calculations which, despite the com[-]plexity of the systems considered, are nevertheles[s] reasonably reliable. The physical and chemica[l] properties of SO_2, SO_3 and molecules of the type R_2SO_2 and R_2SO are discussed on the basis of these structures. In all these molecules it appears that th[e] O–S linkages are best described as double-bonded. A successful correlation between the molecular orbital criterion of bond strengths, namely, the bond order[s] and the O–S bond force constants may be set up. The measure of agreement attained between observed and predicted properties is quite satisfactory.

541.6[4]

3482. Contribution to the thermodynamics of high polymer solutions. V. Solubility of heterogenous polymers. G. GAVORET AND M. MAGAT. *J. Chem. Phys.*, **17**, 999–1000 (*Oct.*, 1949).

541.6[4]

3483. Phase relationships in polymer solutions. H. TOMPA. *Trans. Faraday Soc.*, **45**, 1142–52 (*Dec.* 1949).

The existing statistical theories of polymer solutions are applied to the elucidation of the phase relationships of 3 component systems with at least one polymer component.

541.6[4]

3484. The dimensions of chain molecules containing branches and rings. B. H. ZIMM AND W. H. STOCKMAYER. *J. Chem. Phys.*, **17**, 1301–4 (*Dec.*, 1949).

541.6[4]

3485. Statistical mechanics of dilute polymer solutions. P. J. FLORY. Letter in *J. Chem. Phys.* **17**, 1347–8 (*Dec.*, 1949).

LABORATORY APPARATUS 542.1/.7

542.2 : 621.389

3486. Electronic instrumentation for chemical laboratories. F. GUTMANN. *Proc. Instn Radio Engrs, Aust.*, **10**, 241–56 (*Sept.*, 1949).

A broad survey with 96 literature references.

542.48

3487. Theory of distillation and other countercurrent processes. W. R. VAN WIJK. *Physica*, **15**, 933–50 (*Dec.*, 1949).

A theory of countercurrent processes is presented which is especially applied to distillation. The product of absorption factors on the different trays is the basic function into which other variables, e.g. the concentrations, can be expressed. The equation for the conservation of heat is used to calculate the product of absorption factors and it is applicable to the most general case of distillation, even if chemical reactions occur. An explicit solution is given if the volatilities of the components have a constant ratio in the top section and a (different) constant ratio in the bottom section. The reflux is variable. A graphical representation permits to obtain in one diagram a survey of all possible means by which a desired separation can be obtained. The unspecified components are approximately taken into account in this diagram. A special feature of the theory is that the number of components involved is only of secondary importance.

A.

CHEMICAL ANALYSIS 543/545

544.8 : 539.172.13

3488. Analysis by nuclear transformation. W. RIEZLER. *Z. Naturforsch.*, **4a**, 545–9 (*Oct.*, 1949) *In German.*

Deuteron bombardment was used to reveal the presence of traces of impurities in Fe and Al. From the excitation curve [Abstr. 2935 (1948)], 4 MeV was the most favourable energy for the detection of C in Fe. The detection of Na and Si in Al was also investigated. J. HUGHES

545 : 539.172.4

3489. Microchemical methods used in nuclear research. B. B. CUNNINGHAM. *Nucleonics*, **5**, 62–85 (*Nov.*, 1949).

A detailed study of methods developed mainly for the investigation of rare and synthetic elements. Quartz fibre microbalances are described and theoretical expressions for their sensitivity and stability are given. A discussion of apparatus and methods employed in microchemical studies of aqueous solutions and solid compounds includes descriptions of preparations and analysis of compounds and metals, solubility measurements, specific activity measurements and study of reactions. The investigation of physical properties such as X-ray diffraction patterns, absorption spectra, magnetic susceptibilities, melting points and densities is also outlined. Finally, a brief account is given of the advantages of using microsamples in nuclear bombardment experiments.

L. R. SHEPHERD

545.82

3490. Remarks on the procedure of homologous line-pairs. H. KAISER. *Z. Naturforsch.*, **4a**, 565–70 (*Nov.*, 1949) *In German.*

A reconsideration of Gerlach's method, now somewhat neglected. The effects of electrode and discharge variables are examined, and it is concluded that the method deserves revival, especially with present means of discharge control. S. T. HENDERSON

545.82

3491. Comparison of the procedures of blackening difference and line width in quantitative spectrochemical analysis. W. ROLLWAGEN AND H. WELTZ. *Z. Naturforsch.*, **4a**, 570–3 (*Nov.*, 1949) *In German.*

Photographic, photometric and other factors are discussed. The line width method, though very dependent on spectrographic slit width, has valuable applications especially when the stronger line of a pair shows reversal. S. T. HENDERSON

545.82 : 519

3492. Application of methods of statistical control to spectrographic analysis. R. GIRSCHIG. *Rev. Métall.*, **46**, 719–26 (*Nov.*, 1949) *In French.*

A description of a statistical method applicable to a series of determinations of the same unknown, as in spectrographic analysis. By using the amplitude of the series instead of the quadratic differences from the mean the calculation is much simplified. Trustworthiness of observations and the establishment of significant differences are discussed. S. T. HENDERSON

CRYSTALLOGRAPHY 548

548.0

3493. Preparation of single crystal copper ribbons from single crystal copper rods. A. A. PETRAUSKAS, E. A. COOMES AND J. E. MACDONALD. Note in *Rev. Sci. Instrum.*, **20**, 961–2 (*Dec.*, 1949).

548.0

3494. A technique for cutting metal single crystals. T. R. MCGUIRE AND R. T. WEBBER. Note in *Rev. Sci. Instrum.*, **20**, 962–3 (*Dec.*, 1949).

548.0 : 539.32

3495. Elastic constants of lithium fluoride. T. SESHAGIRI. Letter in *Curr. Sci.*, **18**, 436 (*Dec.*, 1949).

548.1 : 537.228.1 : 621.396.611.21

3496. Standards on piezoelectric crystals, 1949. *Proc. Inst. Radio Engrs. N.Y.*, **37**, 1378–95 (*Dec.*, 1949).

Part I outlines the crystal classes and gives rules

for orienting the orthogonal piezoelectric axes (X, Y, Z) relative to the crystallographic axes (a, b, c). Z is || to c, $Y \perp$ to (010), $X \perp$ to Y and Z. Part II describes the orientation of a cut crystal plate by symbols consisting of two or more small letters enclosed in parentheses. The first letter (x, y or z) gives the axis most nearly parallel to the thickness of the plate, the second the axis most nearly parallel to the length of the plate; further letters (t, w or l) are added if necessary to indicate deviations from exact parallelism expressed as rotations about the *t*hickness, *w*idth or *l*ength. Part III recommends symbols and tabulates conversion factors. The recommended set of symbols is exhaustive and consistent, but differs from any in previous use. A. J. C. WILSON

548.33

3497. On the transition of untwinned $BaTiO_3$ crystals from cubic to tetragonal structure. W. KÄNZIG AND R. MEIER. *Helv. Phys. Acta*, **22** (*No.* 6) 585–8 (1949) *In German.*

The method of measurement of spontaneous polarization from the hysteresis curve is applied to $BaTiO_3$ and it is found that this quantity rises to a sharp max. value of 27×10^{-6} coulombs/cm^2 at just below the Curie pt. (119°C) and then falls sharply at 119°C to a residual value of about 1×10^{-6}. The intensity of X-ray reflection (020) falls slowly with temp. to about 118°C and then falls sharply to zero. In a field of 7 000 V/cm the peak shifts 1·4°C in the direction of increasing temp. C. A. HOGARTH

548.33

3498. Hysteresis ranges of polymorphic transitions of some crystals. L. F. CONNELL, JR. AND J. H. GAMMEL. *Acta Cryst.*, **3** (*No.* 1) (79–80) (1950).

The transition temps. on heating (given first) and cooling (given second) were measured by means of fine-wire thermocouples for the following substances (reagent grade): NH_4NO_3 (orthorhombic → tetragonal) 84·4, 83·7°C; NH_4NO_3 (tetragonal → cubic) 125·6, 125·3°C; $CsClO_4$ (orthorhombic → cubic) 218·6, 203·8°C; $KClO_4$ (orthorhombic → cubic) 299·6, 294·0°C. The temps. are said to be reproducible on successive trials and to be unaffected by the rate of heating. A. J. C. WILSON

548.33

3499. Polymorphism and anion rotational disorder in the alkaline earth carbonates. J. J. LANDER. *J. Chem. Phys.*, **17**, 892–901 (*Oct.*, 1949).

548.51

3500. On the creation of centres of crystallization [nucleation] in supercooled liquids. IX. Production of centres of crystallization of α-salol on particles of rock salt. V. I. DANILOV, A. G. LESNIK AND B. I. SHNAĬDEN. *J. Exp. Theor. Phys., USSR*, **19**, 908–11 (*Oct.*, 1949) *In Russian.*

[See Abstr. 5108, 5781, 3567, 3568 (1949)]. On supercooling salol (m.p. 41·6°C) in the presence of crystallites of NaCl, centres of crystallization are only formed if the NaCl has previously been activated by contact with solid α-salol. The activity of the NaCl is lost on heating to 100°C. This process of nucleation takes place even in the vitreous state and its speed increases with decreasing temp.

A. L. MACKAY

548.5

3501. On the creation of centres of crystallization [nucleation] in supercooled liquids. X. Investigation of the crystallization of the β-modification of salol on particles of rock salt. A. G. LESNIK AND V. I. DANILOV. *J. Exp. Theor. Phys., USSR*, **19**, 912–15 (*Oct.*, 1949) *In Russian.*

[See previous Abstr.]. Crystals of the β-modification (m.p. 30·4°C) are not formed in pure salol even if it is supercooled to — 180°C. If crystallites of NaCl are present β-salol at once crystallizes on cooling to — 50°C and previous activation of the NaCl by contact with solid β-salol has no effect. The number of nuclei formed reaches a max. at — 65°C and decreases slightly for greater supercooling. More nuclei are produced if supercooling is from 100°C instead of 50°C. It is suggested that a structural relationship with the NaCl is responsible for the generation of centres of crystallization on β-salol while surface layers operate in the case of α-salol. A. L. MACKAY

548.52

3502. On the growth of metallic crystals from the vapor phase. G. R. KEEPIN, JR. Letter in *J. Appl. Phys.*, **21**, 260–1 (*March*, 1950).

Experiments using Cd and Zn are described, using various vapour pressures and collector plate temperatures, in a N_2 atmosphere at various pressures. The optimum crystal-forming conditions are given in a table.

548.52

3503. On crystallization of sodium and potassium. V. I. DANILOV AND A. G. POMOGAĬBO. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 5) 843–6 (1949) *In Russian.*

Formation of crystallization centres in undercooled liquid samples of Na and K has been investigated. Both metals were freed from insoluble contamination by vacuum distillation. It has been found that (1) the process of crystallization is strongly affected by the presence of oxides of Na, viz. the limit of metastability is lowered; (2) in purest samples the max. undercooling ($\sim 3 \cdot 5°$) is attained when the limit of metastability becomes sharp; the estimated surface tension between the seed-crystal and the liquid is ~ 2 erg/cm^2 and the kinetic coeff. k is 10^{18}–10^{22}; (3) analogous calculations for samples of Na containing oxides give for the coefficient k values smaller by several degrees of magnitude; the increase of the velocity of formation of crystallization centres is due to a considerable lowering of surface tension. F. LACHMAN

548.52

3504. Growing and processing of single crystals of magnetic metals. J. G. WALKER, H. J. WILLIAMS AND R. M. BOZORTH. *Rev. Sci. Instrum.*, **20**, 947–9 (*Dec.*, 1949).

Single crystals of Ni, Co and various alloys are grown by slow cooling of the melt. They are oriented by optical means and by X-rays, and ground to the desired shape using the technique described. A

548.53 : 539.37

3505. Recrystallization of single crystals after plastic bending. R. W. CAHN. *J. Inst. Met.*, **17**, 121–43 (*Oct.*, 1949).

Experiments have been carried out to determine

under what conditions it is possible to procure in deformed crystals a special type of recrystallization which leads to discontinuous asterisms in the Laue patterns. It has been found that bent single crystals are particularly liable to this type of recrystallization, which has been observed with Zn, Mg, Al and rock-salt. Systematic experiments with Zn crystals have established an optimum bending radius, annealing time, and annealing temp. The microstructures of the bent and of the annealed specimens have also been examined; the annealed specimens consisted of many crystallites separated by straight boundaries perpendicular to the slip planes. The theory of the phenomenon is discussed, and it is concluded that it is the result of the motion of dislocations during annealing. The bearing of the results on the general theory of recrystallization is briefly considered. A.

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

3506. On some possible peculiarities of the dynamics of molecular crystal lattices. Sh. Sh. Raskin, A. V. Sechkarev and F. I. Skripov. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 5) 837–40 (1949) *In Russian.*

548.7

3507. The influence of the symmetry of a crystal on the character of the limiting vibrations of the molecular lattice. F. Skripov. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 6) 1075–7 (1949) *In Russian.*

548.7

3508. Spectra of disordered crystals. D. F. Hornig. Letter in *J. Chem. Phys.*, **17**, 1346 (*Dec.*, 1949).

548.7

3509. Order–disorder transition in beryllium oxyacetate crystals. T. Watanabé, Y. Saito and H. Koyama. Letter in *Nature, Lond.*, **164**, 1046 (*Dec.* 17, 1949).

548.7 : 535.343.2

3510. Theory of the *F* centres of coloured alkali halides. II. Electronic structure of *F* centres—general theory. T. Mutō. *Progr. Theor. Phys.*, **4**, 243–50 (*July–Sept.*, 1949).

The theory of *F* centres in alkali halides, begun in Part I [Abstr. 2068 (1950)] is continued. Improving on Tibbs's calculation of wave functions for electrons in *F* centres, the effect of local structure and of the whole crystal are included. Potential energies of trapped electrons are derived by the method of atomic orbitals and by that of molecular orbitals. Quantitative comparison of results and calculation of numerical values for the eigen states of the electrons are reserved for Part III. G. F. J. Garlick

548.7 : 535.343.2

Colour centres in crystals. *See Abstr.* 3049–51

548.7 : 536.653

3511. The Born–Mayer model for ionic solids and the heats of formation and lattice spacings of alkali halide solid solutions. W. E. Wallace. *J. Chem. Phys.*, **17**, 1095–9 (*Nov.*, 1949).

An expression for the potential energy of a crystalline solution has been developed in terms of the known interaction parameters of the pure constituents and has been used to compute the equilibrium spacings and heats of formation of 3 chosen systems. The calculated results are compared with experiment. The comparison suggests that further refinement in the model is perhaps necessary before the small changes in lattice spacings and heat contents which accompany solid solution formation can be completely accounted for. A.

548.7 : 537.311.33

3512. The condition of impurities in the lattice of smoky quartz. L. G. Chentsova and N. E. Vedeneeva. *Dokl. Akad. Nauk, SSSR*, **68** (*No.* 2) 305–8 (1949) *In Russian.*

The saturation current through slices of smoky quartz at 500°C (cut in various orientations) was measured as a function of time. Along the optic axis the current was initially large, decreasing rapidly: perp. to the axis the current was small. By colouring the crystals by irradiation with X-rays the motion of the ions was seen to be in the direction of the optic axis. If Li ions were introduced the conductivity increased many times. Small cations travelling along channels in the structure ‖ to the optic axis account for the conductivity. A. L. MacKay

548.7 : 537.311.33

Electrons in perturbed periodic lattices. *See Abstr.* 3157–8

548.7 : 537.529

Theory of electron multiplication in crystals. *See Abstr.* 3173

548.7 : 537.531

3513. On the action of X-rays on KCl crystals. H.-U. Harten. *Z. Phys.*, **126** (*No.* 7–9) 619–31 (1949) *In German.*

The photoconductivity of KCl is $\propto$ the intensity of the continuous radiation ($0{\cdot}2 < \lambda < 1$Å), decreases with time to a final constant value which increases rather irregularly with temp., and increases slightly more rapidly than proportionately to the field strength in the range $-180°$ to $+130°$C. At an intensity of irradiation of $1{\cdot}6$ W/m^2 and a field strength of 10^6 V/m the current density was $\sim 10^{-5}$ A/m^2. At low temps. the number of *F* centres produced is $\propto$ the time of irradiation (up to 3 hr), but with increasing temp. the rate of production decreases with time, and at room temp. the concentration appears to approach a constant value ($\sim 7{\cdot}5 \times 10^{16}$ centres per cm^3 at $1{\cdot}6$ W/m^2 at 15°C). The concentration attainable increases with decreasing temp., and below -150°C, *F* centres are also produced. The intensity of radiation was measured calorimetrically by absorbing the X-rays in a hollow Pb cone attached to a Te-constantan thermocouple, and the number of *F* centres by the increase in absorption for monochromatic light. A. J. C. Wilson

548.7 : 539.153.2 : 539.11

Structural investigations by means of nuclear magnetism. *See Abstr.* 3298

548.73

3514. Diffraction by a screw dislocation. A. J. C. Wilson; F. C. Frank. Letters in *Research, Lond.*, **2**, 541–3 (*Nov.*, 1949).

[i] In the reciprocal-space representation, the

regions of strong diffraction are spread out into discs perp. to the dislocation axis. Except for planes parallel to the axis the intensity of diffraction is zero at the exact reciprocal-lattice points. Expressions are given for amplitude of diffraction and apparent particle sizes. [ii] The extent to which the results of the mathematical investigation might have been anticipated is discussed. A. J. C. WILSON

548.73 : 539.155.4

The pykno-X-ray method for determining atomic masses. *See Abstr.* 3336

548.733 : 539.262

3515. X-ray powder diffraction analysis film and Geiger counter techniques. W. PARRISH. *Science*, **110**, 368–71 (*Oct.* 7, 1949).

A general survey of the field, including a description of the optical arrangement of a new spectrometer for use with a Geiger counter. R. B. SHEPHERD

548.733 : 539.264

An X-ray camera for obtaining powder pictures at high pressures. *See Abstr.* 3430

548.735

3516. The X-ray scattering from a hindered rotator. M. V. KING AND W. N. LIPSCOMB. *Acta Cryst.*, **3** (*No.* 1) 73–6 (1950).

An expression is derived for the X-ray scattering from a crystal containing groups of atoms in hindered rotation about fixed axes. A Maxwell–Boltzmann distribution of the orientation angles of the groups is assumed, with a sinusoidally varying hindering potential. Although a corresponding expression is not derived for the hindered rotator without a fixed axis, it is shown that structure-factor data in the particular case of perfluorocyclohexane lead to the conclusion that the molecule is not a free rotator in the crystal, but either may be a hindered rotator or may show orientational disorder. A.

548.735

3517. Vector sets. M. J. BUERGER. *Acta Cryst.*, **3** (*No.* 2) 87–97 (1950); ibid. (*No.* 3) 243.

Every set of points has associated with it a set of vectors joining the points; ideally the vector set corresponding to a set of atoms in a crystal can be derived by Patterson synthesis. The ideal vector set can be resolved to give the point set, unambiguously except for homometric sets [Abstr. 1710 (1944)]. This constitutes the first general proof of the possibility of the determination of crystal structures. The symmetry of the vector set is discussed [Abstr. 7386 (1949)]. The 23 possible space groups of vector sets are given by the centrosymmetric crystal classes prefixed by the symbols of the lattices possible in the class; all symmetry elements of the point set (except a centre of symmetry) are, however, recognizable through concentrations of points in the vector set.

A. J. C. WILSON

548.735.2

3518. The selection rules for X-ray diffraction maxima proper to a coordinate value in various space groups. P. NIGGLI. *Z. angew. Math. Phys.*, **1** (*No.* 1) 71–4 (1950) *In German.*

The character-table method [Abstr. 7387 (1949)] makes it easy to find the maxima to which an atom in a particular position does not contribute.

A. J. C. WILSON

548.735.

3519. A graphical method for calculating the struc ture factors in the X-ray analysis of crystals. W HOPPER AND L. CAMERER. *Z. Naturforsch.*, **4a** 637–9 (*Nov.*, 1949) *In German.*

To calculate the *hk*0 structure factors, a transparen chart is drawn for each value of h, showing the loc (straight lines) of the maxima of $\cos 2\pi(hx + ky$ for various values of k. The chart is placed over drawing of the cell on the same scale, and the valu of $\cos 2\pi(hx + ky)$ found for each atom by measurin its horizontal distance from the line for the appro priate value of k with a scale graduated to show $\cos 2\pi hx$. These values are then multiplied by th appropriate value of f and summed. For the *hk* reflections the scale is displaced by the amoun corresponding to lz; the sine part of F for a non centrosymmetric structure can be found by a dis placement of $\pi/2$. A. J. C. WILSO

548.735.44

3520. The convergence of the least-squares an Fourier refinement methods. D. W. J. CRUICKSHANK *Acta Cryst.*, **3** (*No.* 1) 10–13 (1950).

A comparison is made between the atomic co ordinate corrections given in structure refinement b the least-squares and Fourier methods. For centro symmetric structures the same corrections, whe $<$ about 0·10 Å, are given by both methods. A modified form of the Fourier method is suggested t allow for phase-angle refinement in non-centro symmetric structures, which is equivalent to th least-squares method when the corrections are small. A

548.735.44

3521. The interpretation of diffuse X-ray diagram of carbon. R. E. FRANKLIN. *Acta Cryst.*, **3** (*No.* 2 107–21 (1950).

Results obtained from a Fourier integral analysi are in satisfactory agreement with those deduced fro a comparison of the experimental intensity curv with an intensity curve calculated for a hypothetica structure. It is concluded that, in the C investigated 65% is in the form of highly perfect and plana graphite-like layers of mean diameter 16 Å, and 35% is in a much less organized state, giving only a gas-lik contribution to the X-ray scattering. About 55% o the graphite-like layers are grouped in pairs o parallel layers with an interlayer spacing of 3·7 Å and the remaining 45% show no mutual orientation There is a mean interparticle distance of about 26 Å. A

548.735.44 : 518.

3522. Investigations on Fourier synthesis of th charge distribution in crystals. I. Methods an apparatus for multi-dimensional Fourier synthesis W. DE BEAUCLAIR. *Berlin, Akademie Verlag G.m.b.H* (1949) *pp.* 71 + viii. *In German.*

There are 3 main sections, covering 1-, 2- and 3 dimensional syntheses. Only centrosymmetric struc tures or projections are treated. In addition t devices already known, 2 new ones are described The first, based on frequency-modulated electrica superposition, is applicable to 2-dimensional syn theses. It consists of 15 rows and 13 columns o

special transformers with 3 stator and 1 rotor winding, apparently originally intended for use as indicators in servo-mechanisms. The rotors in each row are coupled together, and successive rows are rotated at frequencies of h times a fundamental of 2 c/s for $h = 1$. The stators of each column are coupled together, and successive columns are geared so that the angular setting of the stators in the kth column is k times that of the $k = 1$ column. The rotors are fed with a carrier frequency of 500 c/s, the current in the (h, k) rotor being $\propto F_{hk}$. One set of stators is connected in series and the output voltage displayed on an oscillograph screen with time base 2 c/s. The individual 500 c/s oscillations are not seen; their envelope gives the electron density as a function of x for the value of y corresponding to the stator setting. The second, for 3-dimensional syntheses, consists of an "angle calculator" driving an "automatic synthesizer." The angle calculator consists of 3 gears, each with 48 teeth arranged staircase-fashion, driving pinions of the same diameter. The pinions are set to engage enough teeth of the gears so that one revolution of the gears produces fractional revolutions of the pinions corresponding to x, y, z (in multiples of 1/48th). The pinions drive a similar set of staircase-gears giving rotations $\propto h$, k, l respectively, and the outputs, $\propto hx$, ky, lz, combine through differentials to give $hx + ky + lz$. This rotation can be read off and used in conjunction with a table of cosines, or can be used to drive a bank of contacts that feed $\cos 2\pi(hx + ky + lz)$ (to any desired number of significant figures) into a calculating machine through magnet-operated keys. Multiplication by F_{hkl} is done in the normal manner and the results summed.

A. J. C. WILSON

548.735.7

3523. Measurement of crystal imperfections and photographically recording spectrometer with 2 crystals. J. FEIFER. *Elektrotech. Obz.*, **38**, 565–70 (*Nov.* 26, 1949) *In Czech.*

The imperfections are partly mosaic errors and partly lattice imperfections. The former do not influence line width in a symmetrical spectrograph arrangement. The author develops the theory of line width and intensity distribution of this arrangement, describes the principle of the 2-crystal spectrometer with ionization chamber recording and explains its use for determining crystal errors. This method does not admit of photographic recording as the use of one rotating crystal leads to a displacement of the reflected line. However, a 2-crystal spectrometer with fixed crystals permits under certain conditions of a photographic recording of the crystal imperfections, especially if the reflective power of the crystal mosaic is high. Tables of error determinations on various crystals are given.

B. F. KRAUS

548.735.7

3524. One-dimensional dislocations. III. Influence of the second harmonic term in the potential representation, on the properties of the model. F. C. FRANK AND J. H. VAN DER MERWE. *Proc. Roy. Soc. A*, **200** 125–34 (*Dec.* 22, 1949).

In the previous 1-dimensional dislocation model, a single sinusoidal term was taken to represent the potential energy of the deposit as a function of its position on the substrate. In this model a more general representation of the potential, containing a 2nd harmonic term as well, is used, and it is shown that the solution in this case is also expressible in terms of elliptic integrals. The displacements corresponding to a sequence of dislocations (or a single one) are calculated. The work done in generating a single dislocation by a force on a free end is derived and the stability conditions for such a chain determined. It turns out that the properties of single dislocations, especially as concerns their application to misfitting monolayers and oriented overgrowth, remain almost uninfluenced, unless the amplitude of the 2nd harmonic term is so large as to produce a new min. and provided the overall amplitude of the potential energy is taken to be constant. When the amplitude of the 2nd harmonic term is large, so that the potential curve has a 2nd min., a complete dislocation splits up into 2 halves which are the 1-dimensional analogues of Shockley's "half-dislocations" in close-packed lattices. The equilibrium separation of the 2 halves, as well as the stability conditions for the existence of a single half, are determined [see Abstr. 6545 (1949)].

A.

548.735.7

3525. One-dimensional disorder in crystals and its effect on X-ray interference. III. Comparison of calculation with experimental results. H. JAGODZINSKI. *Acta Cryst.*, **2**, 298–304 (*Oct.*, 1949) *In German.*

Some experimental results are here compared with calculations previously communicated [Abstr. 6563, 6564 (1949)]. Wurtzite crystals from Thrace show a high degree of disorder which cannot have arisen from transformation of parts of the crystal into zincblende. The rhombohedral modification of carbon seems to be the more stable one at low temps. Rotation photographs of SiC(II) crystals show a low degree of disorder and the general course of the diffuse scattering resembles that of a slightly disordered crystal of the SiC(III) type.

A.

548.735.7

3526. Debye–Scherrer lines and distribution of Bragg domain dimensions in polycrystalline powders. E. F. BERTAUT. *Acta Cryst.*, 3 (*No.* 1) 14–18 (1950) *In French.*

It is shown that a study of the breadth of Debye–Scherrer diffraction lines leads to a determination not only of the mean dimensions of the crystallites in a given direction but also of the statistical distribution of these dimensions.

A.

548.736.1

3527. Atom arrangement of amorphous germanium. O. FÜRST, R. GLOCKER AND H. RICHTER. *Z. Naturforsch.*, **4a**, 540–2 (*Oct.*, 1949) *In German.*

This was investigated by X-ray and Fourier analysis. A model is given explaining the connection between the structure of the lattice and that of the amorphous state.

E. P. WOHLFARTH

548.736.1

3528. Physical properties of polonium. II. X-ray studies and crystal structure. W. H. BEAMER AND C. R. MAXWELL. *J. Chem. Phys.*, **17**, 1293–8 (*Dec.*, 1949).

Structures are proposed which account for the

powder diffraction patterns obtained from samples of Po containing various amounts of Pb. Unusual temp. effects are recorded for α-Po. It is suggested that the Pb and Po are present in interpenetrating primitive cubic lattices which are indistinguishable because the atomic numbers are nearly the same. [See Abstr. 3117 (1950)]. A.

548.736.182

3529. Structure of graphite. J. Hoerni and J. Weigle. Letter in *Nature, Lond.*, **164,** 1088 (*Dec.* 24, 1949).

Extra spots in transmission electron-diffraction patterns require doubling one basal edge of the unit cell. A consistent system of double bonds involves a doubled cell; it is suggested that the extra spots are due to the bonding electrons, the bonds resonating between the possible equivalent directions.

A. J. C. WILSON

548.736.182

3530. Unit-cell dimensions of graphite. G. E. Bacon. *Acta Cryst.*, **3** (*No.* 2) 137–9 (1950).

It is shown that the variation with particle size of the *c* dimension of the graphite unit cell, often reported for small crystallites, can be followed through the range of relatively well-crystallized specimens. The value of *c* is found to be a linear function of the reciprocal of the number of C layers in the crystallite. The *a* dimension remains constant over this range, although there are small displacements of the *hki*0 lines, probably on account of admixture of a proportion of turbostratic material. A.

548.736.3

3531. Changes in the crystal structure of AgBr when exposed to X-rays. J. C. M. Brentano and L. V. C Spencer. *J. Chem. Phys.*, **17,** 944–6 (*Oct.*, 1949).

Controversial evidence has appeared in the literature concerning the constancy of the lattice parameter of AgBr with varying exposure to radiation. This paper gives in detail experiments showing that the lattice parameter does not change appreciably with increasing exposure to X-rays. A.

548.736.3

3532. The structure of Co_2Al_9. A. M. B. Douglas. *Acta Cryst.*, **3** (*No.* 1) 19–24 (1950).

548.736.3

3533. Compounds of uranium with the transition metals of the first long period. N. C. Baenziger, R. E. Rundle, A. I. Snow and A. S. Wilson. *Acta Cryst.*, **3** (*No.* 1) 34–40 (1950).

In the alloy systems of uranium with Mn, Fe, Co and Ni, the following compounds occur: U_6Mn, U_6Fe, U_6Co and U_6Ni, all tetragonal and isostructural and of a new structural type; UCo, a body-centred cubic compound, $Z = 8$, with a unique structure; UNi, structure undetermined; UMn_2, UFe_2 and UCo_2, with the *C*-15 structure; UNi_2, with the *C*-14 structure; UNi_5 with the $PdBe_5$ structure, closely related to the *C*-15 structure. In addition, UCu_5 has a similar structure. Lattice constants and full structure determinations are reported for all compounds except UNi. For the latter, only powder data have been available, and the structure is complex. A.

548.736.

3534. On the crystal structure of the compound $PrGe_2$. A. Iandelli. *Atti Accad. Naz. Lince (R.C. Cl. Sci. Fis. Mat. Nat.)* **6,** 727–34 (*June*, 1949) *In Italian.*

548.736.

3535. Crystal structure studies on β-tungsten oxide. A. Magnéli. *Ark. Kemi*, **1,** *Paper* 59, 513–23 (1949)

In a previous paper a few preliminary data were given concerning the blue monoclinic β-tungsten oxide of the approximate composition $WO_{2.90}$. Further information about this compound has been obtained during a continued investigation and is reported here A

548.736.

3536. Crystal structure of In_2Bi. E. S. Makarov *Dokl. Akad. Nauk, SSSR,* **68** (*No.* 3) 509–10 (1949) *In Russian.*

548.736.422

3537. Observations on the diffuse X-ray reflexion of sodium chlorate, $NaClO_3$. G. N. Ramachandran and W. A. Wooster. *Acta Cryst.*, **3** (*No.* 1) 77–9 (1950).

Geiger-counter measurements of the thermal scattering of X-rays from $NaClO_3$ differ considerably from those made photographically by Garrido [Abstr. 1710 (1948)], and agree within the statistical error (~ 3%) with Jahn's theory [Abstr. 1091 (1942)]. Sen's suggestion [Abstr. 4275 (1949)] that another explanation of the diffuse scattering should be sought is therefore unnecessary. A. J. C. WILSON

548.736.

3538. Domain structure of Rochelle salt and X-ray reflexion. S. Miyake. Commun. in *Acta Cryst.*, 2 (*No.* 3) 192 (1949).

Rocking curves for X-ray reflections from Rochelle salt show that the peak intensities, integrated intensities, and ½-peak widths decrease rapidly in passing from the ferroelectric (below 24°C) to the paraelectric state (above 24°). These observations are most easily interpreted through a domain structure (repeated monoclinic twinning) in the ferroelectric state [see Abstr. 1848 (1941) and Abstr. 1363 (1950)].

A. J. C. WILSON

548.736.

3539. The hydrogen bond in crystals. VIII. The isotope effect in KH_2AsO_4. D. H. W. Dickson and A. R Ubbelohde. *Acta Cryst.*, **3** (*No.* 1) 6–9 (1950).

The axial lengths of tetragonal KH_2AsO_4 are found to be $a = 7{\cdot}609 \pm 0{\cdot}001$, $c = 7{\cdot}148 \pm 0{\cdot}001$ kX at 18°C. X-ray measurements on KH_2AsO_4 show that the isotope effect when D is substituted for H involves a lattice expansion in the direction of the short H bonds. On the basis of certain assumptions, the isotope effect (D for H) involves an expansion of 0·0080 kX in KH_2AsO_4 which compares with 0·0097 kX in KH_2PO_4 and 0·0100 kX in $(NH_4)H_2PO_4$. A

548.736.5 : 536.424

3540. X-ray study of thermal transformations in some magnesian chlorite minerals. G. W. Brindley and S. Z. Ali. *Acta Cryst.*, **3** (*No.* 1) 25–8 (1950).

548.736.5

3541. The crystal structures of warwickite, ludwigite and pinakiolite. Y. Takéuchi, T. Watanabé and T. Ito. *Acta Cryst.*, **3** (*No.* 2) 98–107 (1950).

548.736.5

3542. The crystal structure of hollandite, the related manganese oxide minerals, and α-MnO_2. A. Byström and A. M. Byström. *Acta Cryst.*, **3** (*No.* 1) 146–9 (1950); also *Nature, Lond.*, **164,** 1128 (*Dec.* 31, 1949).

548.736.5

3543. Influence of firing temperatures on the preparation of barium titanate. M. G. Harwood and H. A. Klasens. Letter in *Nature, Lond.*, **165,** 73 (*Jan.* 14, 1950).

548.736.6

3544. Electronographic determination of the unit cells of pyrophyllite and talc and the structural relationship between these minerals and montmorillonite. B. B. Zvyagin and Z. G. Pinsker. *Dokl. Akad. Nauk, SSSR,* **68** (*No.* 3) 505–8 (1949) *In Russian.*

Using electronographic techniques [see Zvyagin and Pinsker, *ibid.*, **68** (*No.* 1) (1949)], two monoclinic layer-structure minerals were examined. 9 different types of pyrophyllite layers (Si_2O_5) can occur and may be stacked in various ways. The unit cell of talc has $a = 5{\cdot}27 \pm 0{\cdot}02$, $b = 9{\cdot}13 \pm 0{\cdot}02$, $c = n(9{\cdot}47 \pm 0{\cdot}07)$ Å, $\beta = 100° 40' \pm 50'$, but it was impossible to resolve reflections which would indicate how the layers are arranged. In pyrophyllite, with $a = 5{\cdot}13 \pm 0{\cdot}02$, $b = 8{\cdot}88 \pm 0{\cdot}02$, $c = 18{\cdot}54 \pm 0{\cdot}10$ Å, and $\beta = 100° 37' \pm 45'$, the two layers are of symmetry C_s^1 and their planes of symmetry are at 120° to each other. The bisector of this angle is the a axis and successive layers are displaced by $a/3$. The space group is $C_{2h}^6 = C2/c$. Montmorillonite (space group $C_{2h}^3 = C2/m$) has the same layers with the same displacement but with their planes of symmetry coinciding. A. L. MACKAY

548.736.6

3545. The crystalline structure of tourmaline. N. V. Belov and E. N. Belova. *Dokl. Akad. Nauk, SSSR,* **69** (*No.* 2) 185–8 (1949) *In Russian.*

The structure of Mg-tourmaline (dravite) has been redetermined. The cell dimensions (hex.) are: $a = 16{\cdot}00$ Å and $c = 7{\cdot}24$ Å. The space group is $C_{3v}^5 = R3m$ and the rhombohedral cell contains one $NaR_9B_3Si_6(O, OH)_{30-31}$ unit. A Patterson projection on to the a–b plane and consideration of ionic radii gave a trial structure from which phases were calculated for Fourier projections. Comparison with other ring silicates dioptase, milarite and beryl facilitated the selection of a structure. The final structure (corresponding to a formula $NaMg_6[Al_3B_3Si_6(O, OH)_{30}]$) shows marked divergences from another recent determination [Hamburger and Buerger, *Am. Miner.*, **33,** 532 (1948)]. The parameters [(x, y, z) hex. cell] found are: Na(1), (0,0,0·855); Mg(6), (0·314, 0·056, 0·200); B + Al(6), (0·176, 0·158, 0·170); Si(6), (0·192, 0·192, 0·604); O_{II}(3), (0·054, 0·107, 0·115); O_{III}(3), (0·243, 0·122, 0·065); O_{IV}(3), (0·146, 0·073, 0·690); O_V(3), (0·102, 0·204, 0·705); O_{VI}(6), (0·183, 0·182, 0·385); O_{VII}(6), (0·297, 0·263, 0·675); O_{VIII}(6), (0·050, 0·260, 0·060). A. L. MACKAY

548.737

3546. The crystal structures of the acid salts of some monobasic acids. I. Potassium hydrogen bisphenylacetate. J. C. Speakman. *J. Chem. Soc.*, 3357–65 (*Dec.*, 1949).

548.737

3547. Crystal structure of δ-benzene hexachloride. A. J. van Bommel, B. Strijk and J. M. Bijvoet. *Proc. K. Ned. Akad. Wet.*, **53** (*No.* 1) 47–58 (1950).

548.737

3548. The crystal structure of *m*-tolidine dihydrochloride. F. Fowweather and A. Hargreaves. *Acta Cryst.*, **3** (*No.* 2) 81–7 (1950).

548.737

3549. The crystal structure of "gammexane," γ-$C_6H_6Cl_6$. G. W. van Vloten, C. A. Kruissink, B. Strijk and J. M. Bijvoet. *Acta Cryst.*, **3** (*No.* 2) 139–43 (1950).

548.737

3550. Patterson and Fourier projections of single molecules of haemoglobin. K. Dornberger-Schiff. *Acta Cryst.*, **3** (*No.* 2) 143–6 (1950).

548.74 : 537.533.73

Influence of focusing of the electron beam on the fineness of the diffracted rays. *See Abstr.* 3190

GEOPHYSICS 55

550.312 : 526.72

3551. The British submarine gravity surveys of 1938 and 1946. B. C. Browne and R. I. B. Cooper. *Philos. Trans. A* (*No.* 847) 243–310 (1949).

Detailed account of surveys made with Vening Meinesz pendulum apparatus in submarines near continental shelf in E. Atlantic and Bay of Biscay. Echo sounding records show that edge of shelf off mouth of the English Channel has very rugged topography. In shallow water scatter of gravity measurements is of same magnitude as in SW. England, but in deep water it is nearly twice as great. The area has a mean positive anomaly. The increase in isostatic anomaly on crossing the edge of the shelf from shallow to deep water is again confirmed and provides supporting evidence for presence of wedge-shaped layer of sediment on landward side. E. M. FOURNIER D'ALBE

550.312 : 526.76

3552. On the best dimensioning of the bifilar gravimeter. H. Voit. *Geofis. Pura Appl.*, **15,** 90–110 (*July–Sept.*, 1949) *In German.*

550.34

3553. Energy flux of seismic surface waves. C. Y. Fu. *Sci. Rec., Shanghai,* **2,** 322–7 (*April,* 1949).

A cylindrical wave packet incident on a free boundary is considered. This packet may be represented by an integral of plane waves. For these plane waves, if the angle of incidence is > the critical angle,

the reflected wave becomes a surface wave. The energy flux of these surface waves is studied, and the normal component of the energy flux is evaluated.

L. S. GODDARD

550.36

3554. The radioactivity of the earth. C. FESTA AND M. SANTANGELO. *Ann. Geofis.*, **2**, 503–17 (*Oct.*, 1949) *In Italian.*

After reviewing recent work on the distribution of radioactive minerals in the earth's crust, the authors consider its bearing on the problems of the age of the earth and of the geothermal gradient. For the former they accept Holmes's figure of $3{\cdot}35 \times 10^9$ yr as the most reliable. The geothermal gradient of about 30°c/km could, they suggest, be caused by a layer of granite of 10–20 km thickness. The most urgent need is for further experimental data.

E. M. FOURNIER D'ALBE

550.383

3555. Relation between geomagnetic daily variation and subterranean geological conditions. K. BURKHART. *Naturwissenschaften*, **36** (*No.* 12) 372–3 (1949) *In German.*

550.834

3556. Seismic wave propagation. D. H. CLEWELL AND R. F. SIMON. *Geophysics*, **15**, 50–60 (*Jan.*, 1950).

Speculations are made regarding the significance of the well-known observation that seismic reflection energy is usually in the frequency range of from 20 to 100 c/s. The general absence of reflected energy below 20 c/s is attributed to the fact that the wavelengths of seismic waves in this frequency range are becoming large compared to the thicknesses of reflecting beds. A.

550.834

3557. Some considerations of the mechanism of the generation of seismic waves by explosives. G. MORRIS. *Geophysics*, **15**, 60–9 (*Jan.*, 1950).

550.838

3558. Airborne equipment for geomagnetic measurements. L. H. RUMBAUGH AND L. R. ALLDREDGE. *Trans. Amer. Geophys. Un.*, **30**, 836–48 (*Dec.*, 1949).

The airborne magnetometer AN/ASQ-3A has been modified and auxiliary equipment has been developed to meet requirements for constructing isomagnetic contours of the total magnetic field over extensive areas for use in magnetic prospecting. The principal features of the instrument system are: (*a*) a self-oriented magnetometer which utilizes the output of a system of saturable inductors to provide a d.c. response of low noise level and drift rate; (*b*) instruments for aiding the pilot to follow predetermined lines of a grid or network covering the area to be explored; and (*c*) an interlocked group of recorders for automatically correlating a continuous magnetometer record with plane position and altitude. A.

550.839 : 621.318.572

3559. Portable Geiger counter for drill holes. A. ROBERTS. *Radio Electronic Engng*, **13**, 16–17, 21, 28 (*Sept.*, 1949).

A single-ended self-quenching G.–M. tube with 1 kV applied is mounted on the end of 1 000 ft of cable and can be lowered down a 1¼-in bore hole. The difficulties in making the G.–M. tube assembly water-proof under 1 000 ft of water are briefly dis cussed. The cable is kept on a drum with whic rotates the counter. The tube voltage is generate by rectifying the voltage peaks across a choke in on anode circuit of a multivibrator. A 2-stage R filter smoothes this supply. The tube signal i amplified (2 stages, ×2 500). The resulting pulse which are about 300 μsec long, operate a 2-valv trigger circuit; the second valve of this is a pentagri which is also fed from a 1 kc/s neon oscillator. Th output is applied through a further valve to a lou speaker and is simultaneously rectified to give measure of the rate of counting. Batteries are use for power supply. C. F. BROCKELSBY (R

550.9

3560. The age of the earth. C. MORELLI. *Ann Geofis.*, **2**, 417–35 (*July*, 1949) *In Italian.*

A review of the methods which have been employe to determine the age of the earth's crust. The autho accepts Bullard and Stanley's value of 3 290 200 million yr, based on an analysis of the ratio c the Pb isotopes 206 and 207, but considers the ag of the solar system to exceed 10 000 million yr.

E. M. FOURNIER D'ALB

550.9

3561. Lead isotopes and the age of the earth H. JEFFREYS. Letter in *Nature, Lond.*, **164**, 1046– (*Dec.* 17, 1949).

A reply to a criticism by Holmes [Abstr. 359 (1949)]. The author also comments on the recen analysis by Bullard and Stanley [*Ver. finn. geodäti Inst.* (*No.* 36) 33 (1949)], which gave for t_0 a value o 3 290 ± 200 million yr, and criticizes their rejectio of the Joplin and Austrian leads in their estimate o the probable error of their result.

E. M. FOURNIER D'ALB

ATMOSPHERE . METEOROLOGY 551.5

551.5

3562. On a physical basis for numerical prediction of large-scale motions in the atmosphere. J. G CHARNEY. *J. Met.*, **6**, 371–85 (*Dec.*, 1949).

A method is given for reducing the 3-dimensiona forecast problem to a 2-dimensional one by con struction of an "equivalent-barotropic" atmosphere The method is applied to the calculation of the 500 mb height tendency, and the results are compared wit observation. A rule is derived for determining th positions of the isallohyptic centres from the field o the absolute-vorticity advection. A

551.510.53

3563. Distribution in height of ionization and th recombination coefficient of the *F* layer of the iono sphere. A. A. AINBERG. *J. Exp. Theor. Phys. USSR*, **19** (*No.* 6) 515–20 (1949) *In Russian.*

Results are presented on the calculations of th high-frequency characteristics of the *F* layer usin a method which takes into account the true distributio of ionization with height. The diurnal variation of *i* at various heights (from 250 to 400 km) is presented

and a calculation is made of the coeff. of recombination assuming the law of simple recombination.

BOOKHAVEN GUIDE TO RUSSIAN LITERATURE

551.510.535

3564. Sporadic ionization at high latitudes. J. H. MEEK. *J. Geophys. Res.*, **54**, 339–45 (*Dec.*, 1949).

Sporadic ionization is defined as traces seen on *h'f* ionospheric records which show rapid or erratic variation in frequency or vertical height as compared with the normal region traces. Such records are quite common at northern Canadian stations. 4 types of *F*-region sporadic ionization and 5 types of *E*-region ionization are described. Continuous sweeps taken at Baker Lake, Canada, illustrate the variation of some of these types of sporadic ionization. Estimates were made of the speeds of motion over the station of some of the sporadic "ionized clouds." These in a few measurable cases ranged from 400 km/hr for clouds at 100 km virtual height to 1 200 km/hr for clouds at 300 km virtual height. A.

551.510.535

3565. Analysis of virtual height-frequency records. U. C. GUHA. *J. Geophys. Res.*, **54**, 356–62 (*Dec.*, 1949).

Deals with the problem of deciding whether or not the hypothesis that the distribution of ionization in the upper atmosphere at a particular time consisted of one or more Chapman layers is consistent with the experimental virtual height-frequency records obtained at that time. A new mathematical method is developed to give an approximate expression for the virtual height of the level of reflection of the ordinary ray at lower latitudes—reflected normally from a Chapman layer in terms of the constants of the layer and the frequency of the ray. This leads to a simple and direct way of analysing virtual height-frequency records in terms of the constants of the best fitting Chapman layer. A.

551.510.535

3566. The problem of the ionospheric regions. M. NICOLET. *J. Geophys. Res.*, **54**, 373–81 (*Dec.*, 1949) *In French.*

Indications are given of the problem of the formation of ionospheric regions by processes of light absorption, emission and recombination in the upper atmosphere. U.v. light from the sun through photo-dissociation and photo-ionization affects constituents of the atmosphere. The effects on O, ozone, Na, water vapour, N, N_2O and He are described. Formulae are derived which permit estimates of conditions at levels of ionization, and of the variation of coeff. of recombination with height. Values of coeffs. of absorption for various constituents of the atmosphere are given in the range of about 2 795 Å to 665 Å. Conditions for maximum production of electrons in the ionosphere are studied. A.

551.510.535

3567. Ionosphere and weather. E. GHERZI. Letter in *Nature, Lond.*, **165**, 38 (*Jan.* 7, 1950).

It is suggested that the observation of an *E* or an *F* reflection at normal incidence on 6 Mc/s, at Shanghai and at Hong Kong, has shown a marked correlation with local weather conditions. W. J. G. BEYNON

551.510.535 : 523.5

Meteor ionization in the upper atmosphere. *See Abstr.* 2865

551.510.535 : 523.72

Solar noise and ionospheric fading. *See Abstr.* 2871

551.510.535 : 538.566.3 : 621.396.11

The regular behaviour of long and very long waves returned from the ionosphere. *See Abstr.* 3286

551.510.535 : 538.566.3 : 621.396.11

3568. Irregularities in the horizontal plane of the ionosphere. *Proc. Phys. Soc., Lond. B*, **63**, 148–50 (*Feb.*, 1950).

Abstracts only of 5 papers delivered at Cambridge conference, July 14–16, 1949 [for one, see Abstr. 3288 (1950)].

551.510.535 : 621.396.11

3569. Theoretical considerations regarding the formation of the ionized layers. D. R. BATES AND M. J. SEATON. *Proc. Phys. Soc., Lond. B*, **63**, 129–40 (*Feb.*, 1950).

The detailed mechanisms involved in the formation of the *E*, F_1, F_2 and *D* layers by solar u.v. radiation are discussed. Use is made of the results of some recent calculations on the continuous absorption cross-section of atomic O and N, and of the evidence on the ionic composition of the layers that is provided by the analysis of the emission spectrum of the upper atmosphere during twilight. The uncertainties existing at present are emphasized. A.

551.510.535 : 621.396.11

3570. The formation of ionized regions. *Proc. Phys. Soc., Lond. B*, **63**, 147–8 (*Feb.*, 1950).

Abstracts only of 2 papers given at Cambridge Conference, July 14–16, 1949 [for one, see Abstr. 3569 (1950)].

551.510.4 : 523.77

Atmospheric HDO. *See Abstr.* 2880

551.513

3571. A new dynamical climatology: its aim and method. A. GIÃO. *Geofis. Pura Appl.*, **15**, 114–29 (*July–Sept.*, 1949).

By dynamical climatology is understood the branch of mathematical meteorology which aims at a deduction of the mean properties of the atmospheric perturbations that are compatible with a given mean field of temp., wind and pressure. The fundamental equations of the author's theory of perturbations are recalled and a general equation for the pressure variations at sea level is deduced. From this equation the different elements of dynamical climatology are then derived, for instance the stability of the mean field, the mean trajectories of the perturbations, the frequencies with which they are visited, the regions of deepening and filling or of birth and death of the perturbations, etc. These results explain many observational facts and empirical rules about the mean behaviour of the atmospheric disturbances at sea level throughout the year. A.

551.515

3572. Local structure of atmospheric turbulence. A. M. OBUKHOV. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 4) 643–7 (1949) *In Russian.*

551.525

3573. On the measurement of temperatures in the neighbourhood of the ground. M. NICOLET. *Inst. Roy. Met. Belg. Mem.*, **32** (*No.* 38) 3–8 (1949) *In French.*

The conditions necessary for the correct measurement of temps. immediately above and below the surface of the ground are briefly discussed. By reference to 4 continuous records, taken on different days, of the total radiation received at the ground, and of temps. at 1 m below the ground, at 1 cm below grass and below bare ground, and of the air, it is emphasized that temps. should be recorded not only at the depths recommended by the 1947 Washington international meteorological conference, but also in the surface layer ($\leqslant$ 1 cm) under grass and under bare ground. S. WEINTROUB

551.539.3 : 535.343.4

3574. Atmospheric absorption of heat radiation by water vapour. T. G. COWLING. *Phil. Mag.*, **41**, 109–23 (*Feb.*, 1950).

It is shown that existing experimental results are all consistent with Lorentz collision-broadening. A law is derived for the variation of absorption with amount of water vapour; this law differs somewhat from that proposed by Elsasser, indicating a slower extinction of radiation than the latter. The correction for pressure variations is found to be $>$ Elsasser's normally; the temp. correction agrees with his. A.

551.543.1

3575. On the practical determination of lunar and luni-solar daily variations in certain geophysical data. K. K. TSCHU. *Aust. J. Sci. Res. A*, **2**, 1–24 (*March*, 1949).

A continuation of earlier work, in which Chapman and Miller [*Mon. Not. Roy. Astr. Soc., Geophys. Suppl.*, **4**, 649 (1940)] developed the mathematical theory of a convenient method for the determination of the lunar daily variations in geomagnetic and meteorological elements, and for estimating the probable error of any determination thus made. Important practical details of the work are given in the present paper, with examples of the calculations on suitable computing forms. It also includes a new application of the Chapman–Miller method to the determination of a luni-solar periodic component first predicted and investigated in ionospheric data by Martyn [Abstr. 1072, 2338 (1947)]. A.

551.55

3576. Exact particle trajectories for nonviscous flow in a plane with a constant Coriolis parameter. G. E. FORSYTHE. *J. Met.*, **6**, 337–46 (*Oct.*, 1949).

The pressure and density fields are assumed known exactly for all time, and the wind is to be forecast by obtaining the trajectory of each air particle from the equations of nonviscous motion in a plane. The importance of initial conditions is stressed. For sufficiently simple pressure and density fields the particle trajectories and hodographs may be obtained explicitly without approximation. The appropriate mathematical methods are reviewed. When the pressure force depends only on time, the solutions are compared with the Brunt–Douglas "isallobaric-wind" formula. For one case of stationary circular isobars the exact solution is shown to consist of a superposition of so-called "normal" and "abnormal" solutions of the gradient wind equation. Explicit trajectories believed to be new are found for an air parcel in a certain high-pressure centre whose horizontal pressure gradient is $\geqslant$ that of the so-called max. anticyclone. The general nonlinear case of circular isobars is discussed. Several numerical examples are included. A.

551.55

3577. On surface friction and turbulence in the ocean. C. S. DURST. *Mon. Not. Roy. Astr. Soc. Geophys. Suppl.*, **5**, 369–73 (*Oct.*, 1949).

Values of the coeff. of surface friction between the ocean and the overlying air are deduced from pilot balloon observations. They would seem to indicate that this coeff. varies directly as the wind speed, the proportionality expressed in c.g.s. units being about 7×10^{-7}. On this assumption, the coeff. of turbulence, k, in the ocean is estimated to be represented by $k = 7{\cdot}3\times10^{-11}(V_s)^4$, where V_s is the surface wind speed. A.

551.55

3578. The application to micrometeorology of the theory of turbulent flow over rough surfaces. O. G. SUTTON. *Quart. J. Roy. Met. Soc.*, **75**, 335–55 (*Oct.*, 1949).

The various theories of rough flow are discussed and the conclusion reached that the formulation due to Rossby and Montgomery, in which the influence of the surface irregularities dies out with height, is the treatment most appropriate for meteorology. It is shown that the introduction of a characteristic parameter termed the macroviscosity, defined as the product of the friction velocity and the roughness length, enables a single logarithmic profile to be defined for both rough and smooth flow. Finally the theory of atmospheric diffusion previously advanced for smooth flow is extended to rough flow in conditions of neutral equilibrium, and shown to be in good agreement with observation. A.

551.578.11 : 621.396.

3579. An investigation of the dimensions of precipitation echoes by radar. J. R. MATHER. *Bull. Amer. Met. Soc.*, **30**, 271–7 (*Oct.*, 1949).

A study of the dimensions of precipitation areas as they appear on radar screens. Measurements of the vertical thickness and the horizontal diameter of these areas are made for both cold- and warm-frontal weather situations. It is found that echoes associated with cold fronts are taller in vertical extent and smaller horizontally than echoes associated with warm fronts. There is a small seasonal variation. Echo dimensions are also compared with the stability of the air. As the air becomes more unstable the precipitation echoes become larger both vertically and horizontally. A.

551.578.

3580. Experiments in seeding cumuliform cloud layers with dry ice. E. J. SMITH. *Aust. J. Sci. Res. A*, **2**, 78–91 (*March*, 1949).

Describes 5 expts. in which granulated dry ice was dropped into layers of cumulus cloud at temps. below freezing. In each case precipitation of snow

or ice crystals occurred, and part or all of the cloud dispersed. Displays of haloes and similar phenomena were observed. A.

551.593

3581. Researches on optical phenomena of the upper atmosphere carried out at the observatories of Lyon and Haute-Provence since 1940. J. DUFAY. "*Relations between solar and terrestrial phenomena*," *Sixth report, I.C.S.U.*, 144–56 (1948) *In French.*

A comprehensive account of the work of a team of investigators under the auspices of the University of Lyon during the period, 1940–46. The researches comprise observations of twilight phenomena, light of the night sky, zodiacal light and low-altitude aurorae, together with ancillary laboratory investigations. A full bibliography is appended. D. R. BARBER

551.593

3582. The propagation of visible and infra-red radiation through fog. A. ARNULF, J. BRICARD AND C. VERET. *C.R. Acad. Sci., Paris*, **230**, 565–7 (*Feb.* 6, 1950) *In French.*

551.593.12

3583. An observation on the height of [atmospheric] layers causing scintillation. J. COULOMB AND R. BOUTTET. *C.R. Acad. Sci., Paris*, **228**, 1659–60 (*May* 23, 1949) *In French.*

An optical method is given for calculating the height of turbulent atmospheric layers which give rise to the scintillation of stars. The method increases in accuracy with the difference between the respective refractive indices. A laboratory experiment shows that two layers, simultaneously turbulent, do not vitiate the results obtained for each of them.

R. A. WEALE

551.593.12 : 612.84 : 525.722

3584. The scintillation of stars. C. C. L. GREGORY, J. D. MORTON AND C. J. P. CAVE; H. HARTRIDGE. Letter in *Nature, Lond.*, 146–7 (*Jan.* 28, 1950).

The "physiological" explanation of this phenomenon [Abstr. 2844 (1950)] is criticized because (*a*) scintillation is worse under bad than under good atmospheric conditions; (*b*) in this country, it is worse when the wind is in the east [Gregory]; (*c*) Sirius scintillates [Cave]; (*d*) Sirius, seen through a misted window, appeared as a large area of diffuse blue-white light subtending 5°, and fluctuated markedly at roughly the same frequency as the plane star image [Morton]. Hartridge quotes 5 effects he would expect if the "atmospheric" theory were tenable: they are not observed, hence the physical explanation alone will not suffice. R. A. WEALE

551.593.5

3585. Absorption of solar radiation in the upper atmosphere. M. NICOLET. "*Relations between solar and terrestial phenomena*," *Sixth report, I.C.S.U.*, 125–43 (1948) *In French.*

A critical review of the theoretical and practical problems involved in a study of the chemical and physical constitutions of the earth's upper atmosphere by means of optical and radio soundings, with emphasis on the role of solar radiations in relation to the phenomena observed. A useful table of absorption coefficients for the various states of the principal atmospheric constituents, and a comprehensive bibliography are included. D. R. BARBER

551.593.5

3586. The criterion of the stability of the optical properties of the atmosphere. E. V. PIASKOVSKAYA-FESSENKOVA. *Astr. J., USSR*, **26** (*No.* 3) 175 (1949) *In Russian.* English Abstr. in *Astr. News Letter* [*Harvard*] *No.* 46.

Observations of surface brightness of the daytime sky are discussed. It is shown that a unique correspondence between the coefficient of transmission p and the scattering function $\sigma f(\theta)$ does not exist. The conventional conclusion that a linear relation between F, the solar radiation, and m, the air mass, indicates uniformity may be invalid due to gradual changes of p. Fessenkoff's method of plotting the ratio of the brightness of the sky at a fixed distance from the sun to that of the sun itself, E/E_0, against m also yields a linear relation under uniform conditions which is more sensitive, but which can sometimes fail to indicate gradual changes of p or $\sigma f(\theta)$. Observations of E/E_0, reduced to $m = 1$, when plotted against the observed p (determined from the slope of log F) define two distinct curves; it is suggested that one corresponds to scattering by particles, the other by water molecules. Surface sky brightness near the sun is thus not a reliable index of transparency.

M. W. OVENDEN

551.593.5

3587. Sky brightness in the neighbourhood of the sun. S. GÜNTHER. *Optik*, **5**, 240–57 (*July*, 1949) *In German.*

Coronagraph observations of scattered blue, green and red light from 2′ out to 16° from the sun's limb indicate the presence of scattering particles of size range, 5 μ–150 μ. The scattering function over the same angular distance depends strongly on both water vapour and ice-crystal content of the atmosphere.

D. R. BARBER

551.593.5

3588. A comparison of photographic and photoelectric measurements of atmospheric attenuation of brightness contrast. H. S. COLEMAN AND H. E. ROSENBERGER. *J. Opt. Soc. Amer.*, **39**, 990–3 (*Dec.*, 1949).

The comparison involved the use of a photoelectric telephotometer and a photographic telephotometer of practically the same optical and mechanical design. Atmospheric attenuation of brightness contrast data was obtained for 4 practically monochromatic regions of the visible spectrum using plane objects subtending the same angle with respect to the point of observation and covering a range of approximately 8 miles. The data obtained using the two types of equipment were found to be in close agreement. A.

551.593.5 : 525.735

Dependance of atmospheric extinction on wavelength. *See Abstr.* 2892

551.593.5 : 535.343.4

3589. The transmission of the atmosphere in three regions of the visible spectrum ($\lambda_A = 452$ $\mu\mu$; $\lambda_V = 526$ $\mu\mu$; $\lambda_G = 537$ $\mu\mu$), deduced from photographic observations of stars made in Catania during the summer. E. DE CARO AND E. FICHERA. *Mem. Soc. Astr. Ital.*, **20** (*No.* 4) 275–301 (1949) *In Italian.*

551.593.5 : 535.343.4

3590. Spectrophotometric studies on the transparency of a hazy atmosphere. A. ARNULF AND A. BAYLE. *Rev. Opt. (Théor. Instrum.)* **28,** 691–705 (*Dec.*, 1949) *In French.*

Details are given of the apparatus and methods used in experiments between 1936 and 1940. For haze whose optical density did not exceed 2·0 for a wavelength 0·7 μ, the general results found were: (1) absorption decreases as the wavelength increases and becomes very small towards 9 μ; (2) two kinds of characteristic curves are obtained, one (corresponding to least absorption) when the atmosphere is dry, and the other for a damp atmosphere. The slope of the curves is considerable for short waves (0·4 μ) but decreases gradually and becomes negligible towards 9 μ. R. S. READ

551.593.55

3591. Report on researches carried out by the authors on lines of the twilight- and night-sky during 1940–47. J. BRICARD AND A. KASTLER. "*Relations between solar and terrestial phenomena,*" *Sixth report, I.C.S.U.*, 159–65 (1948) *In French.*

If, as is believed, the twilight emission of the *D* lines by atmospheric Na results from optical resonance, the line width should be $\sim 10^{-3}$ Å. To test this, use has been made of a monochromatic absorbing filter consisting of a chamber, fitted with plane-parallel windows, which contains heated Na vapour. If the line emission is due to resonance radiation from Na atoms at temperature θ, it will be completely absorbed when the vapour has a saturation pressure corresponding to a temperature $\theta_1 > \theta$. It is found that the *D* lines disappear completely at $\theta_1 = 200$°C: from this result a width of 0·03 Å is found for the interval 100°–300°C, i.e. of similar magnitude to that expected from resonance theory. Systematic measures of the enhanced Na emission at twilight indicate a wide range of intensities, with a maximum value of 2×10^{-7} candle/cm² in November, a fluctuation analagous to that of the night-sky emission at 5 893 Å. D. R. BARBER

551.593.55

3592. Some investigations at the Arosa light-climatic observatory touching solar-terrestrial relationships. F. W. P. GÖTZ. "*Relations between solar and terrestrial phenomena,*" *Sixth report, I.C.S.U.*, 166–8 (1948).

Measures of total atmospheric O_3, now extending over 20 yr, show little influence of the 11-year sunspot period. Small-amplitude cycles of 27 and 15·5 d are found, the latter showing minima on June 21st and Sept. 22nd. Observations of aurorae at Arosa (lat. 47° *N.*) establish that lines 3 467 Å and 5 199 Å (atomic *N.*) are characteristic of low-latitude aurorae at sunspot maximum. A unique photograph of a bright night-sky, with luminous striated (ionospheric) structure, is reproduced: such nights occur especially between years of sunspot maxima and minima, and are quite distinct from luminous night-clouds. D. R. BARBER

551.593.55

3593. Densities of the upper atmosphere [deduced] from twilight brightness at the zenith. F. LINK. "*Relations between solar and terrestrial phenomena*" *Sixth report, I.C.S.U.*, 169–70 (1948) *In French.*

By the use of a photometer incorporating a 3-sta electron multiplier and i.r. sensitive photo-cell, t zenithal crespuscular brightness has been measur over the range of solar depression, $0° < U < 1$ By the method already described [*C.R. Acad. Sc Paris*, **200,** 78 (1935)], the results are used to determi the change of atmospheric density with altitu from 50 km to 180 km. A table of the comput density values is given for intervals of 10 km up 90 km, and of 20 km from 100 km to 180 km. D. R. BARB

551.593.

3594. The spectrum of the night sky. R. W. PEARSE. "*Relations between solar and terrestri phenomena,*" *Sixth report, I.C.S.U.*, 180–5 (1948).

The spectral radiation from the night sky, distinct from that of moonlight and polar aurora appears the same for all azimuths, and for all par of the earth. The line or band spectrum is ve complex, and superposed on a faint continuum, t latter showing the solar Fraunhofer absorption Prominent members of the line spectrum are t forbidden radiations of O at 5 577, 6 300 and 6 364 and the Na doublet at 5 893 Å. To the short wa side of 3 900 Å lie numerous bands belonging N_2, O_2, NH, CH and possibly CO. Althou measures in this region made by different observe are in good agreement, the identifications are as y uncertain. D. R. BARB

551.593.

3595. Secondary scattering at dusk for vario structures of the atmosphere. N. M. SHTAUD *Dokl. Akad. Nauk, SSSR,* **64** (*No.* 6) 819–22 (194 *In Russian.*

551.593

3596. Measurement of visibility by photograph photometry. C. STEFFENS. *Industr. Engng Chem* **41,** 2396–9 (*Nov.*, 1949).

A method has been developed for measuri photographically the extent to which visual range ha been reduced by haze. Black objects that are fa enough away to be partially obscured are phot graphed; the photographic densities of the images the objects and of the adjacent sky, if it can be see are measured on the negative. The visual range calculated from these densities, as are the distance the object and the contrast of the film. The errors t be expected by the method, if the horizon sky can b used as one object, are < 10% with readily availab equipment and can be reduced to 2% with increase expense and care.

551.593

3597. Night-sky radiation in the infra-red regio V. L. KRASOVSKIĬ. *Dokl. Akad. Nauk, SSSR,* 6 (*No.* 1) 53–4 (1949) *In Russian.*

551.593

3598. Measurement of the green line of the night-sk light by a photometer with secondary electron am plification. S. F. RADIONOV, E. N. PAVLOVA AN E. V. RDULTOVSKAYA. *Dokl. Akad. Nauk, SSS* **66** (*No.* 1) 55–7 (1949) *In Russian.*

551.593.9

3599. An automatic scanning and recording photometer for night sky studies. D. MARLOW AND J. C. PEMBERTON. *Rev. Sci. Instrum.*, **20**, 724–6 (*Oct.*, 1949).

Describes a photoelectric photometer which scans the entire sky in 32 min, recording the light energy in a 100 Å band as a function of altitude and azimuth. The light is chopped by a rotating shutter and detected by a photo-multiplier tube, the output from which is amplified and synchronously rectified to produce a d.c. signal for the graphic recorder. 3 different types of automatic scanning are provided, as well as a manual control of the various functions. The min. energy which may be reliably recorded, using a 4-in $f:1$ lens, is of the order of 10^{-13} W. A.

551.593.9

3600. Night sky radiations from the upper atmosphere. E. O. HULBURT. *Amer. J. Phys.*, **17**, 463–7 (*Nov.*, 1949).

A factual survey of present knowledge concerning the nature, and origin of the light of the night sky, excluding polar aurorae. D. R. BARBER

551.593.9 : 522.855

3601. On the contribution of the extragalactic nebulae to the intensity of the night sky light. G. DE VAUCOULEURS. *Ann. Astrophys.*, **12**, 162–3 (*April–June*, 1949) *In French.*

At the limit of present observations, mag. 21, the rate of increase of the number of nebulae is $>$ the decrease of intensity due to the lower apparent brightness, but the increasing red shift combined with the variation of the photometric sensitivity with wavelength lead to the conclusion that the effect of nebulae of magnitudes > 28 is negligible. Extrapolating Hubble's expressions for the magnitude distributions of observed nebulae gives a contribution of $< 0{\cdot}3\%$ in the photographic region, although the contribution in the red and infrared may amount to a few %. M. W. OVENDEN

551.594

3602. The charge of a radioactive collector when in a wind current. R. CIALDEA, A. LO SURDO AND G. ZANOTELLI. *Ann. Geofis.*, **2**, 317–27 (*July*, 1949) *In Italian.*

The effect of an air current parallel to the lines of the electric field upon the charging of a radioactive collector placed inside a plate condenser is discussed. From theoretical considerations it is concluded that for small velocities the air current may retard or accelerate the charging process according to the position of the collector, while for large velocities the charging is always retarded. Results of experiments which agree with the above deductions and illustrate the effect of the dimensions of the collector are given. M. DOPORTO

551.594.11

3603. The unitary variation of the potential gradient of atmospheric electricity. N. A. PARAMONOV. *Dokl. Akad. Nauk, SSSR*, **70** (*No.* 1) 37–8 (1950) *In Russian.*

551.594.21

3604. On Frenkel's theory of the origin of atmospheric electricity. N. K. SAHA. *Proc. Nat. Inst. Sci. India*, **15**, 277–81 (*Sept.–Oct.*, 1949).

Discussion of Frenkel's theory of the charge separation in thunderclouds [Abstr. 1125 (1948)]. The author concludes that the preferential absorption of negative ions by water drops, due to an electrical double layer at the drop surface, cannot give rise to fields $> \sim 1$V/cm within the cloud and that thunderstorm fields must be attributed to some other process. E. M. FOURNIER D'ALBE

551.594.22

3605. Spectra of lightning photographed with an objective-prism. M. DUFAY AND J. DUFAY. *C.R. Acad. Sci., Paris*, **229**, 838–41 (*Oct.* 24, 1949) *In French.*

Spectra of single lightning discharges, covering the altitude range, 36 m to ground level, have been recorded with an o-p camera (dispersion, 44 Å/mm at 4 000 Å, and 197 Å/mm at 6 000 Å). Lines due to N II and O II are prominent, and their intensities are found to decrease with increasing height, confirming the results of Israel and Wurm (1947). This explains partially the great differences of intensity obtained previously from slit spectrograms of lines due to neutral and ionized atoms. It is found also that the Balmer series of H are noticeably broadened and, assuming Stark effect, the observed line width (H_β) corresponds to an intermolecular field ~ 20–40×10^3 V/cm, the fraction of mols. and atoms ionized being $\sim 5 \times 10^{-4}$. D. R. BARBER

551.594.5

3606. A new high light gathering power spectrograph for auroral studies. W. PETRIE. *Canad. J. Res. A*, **27**, 231–3 (*Nov.*, 1949).

Consists of two $f\,2{\cdot}5$, 12-in aircraft camera lenses, and a 15 000 lines/in plane grating with ruled surface 4 in by 4 in. The grating concentrates light in the second order spectrum; the dispersion in this order for normal incidence is 22 Å/mm. Spectra obtained in the spring of 1949 include several interesting features, one of which is a strong radiation of wavelength 4 320 Å in the second order. This radiation is likely to be an intense first order i.r. feature. A.

551.594.5

3607. Some results of observations, and photographic measurements of Aurorae Boreales in southern Norway since 1911. C. STØRMER. *Trans. Chalmers Univ. Tech., Gothenburg* (*No.* 90) 34 *pp.* (1949) *In French.*

A summary of 35 739 photographic observations made at Oslo, Bossekop, and a number of secondary stations in S. Norway between 1911 and 1948, with the results of a statistical study of height-frequency relationships for various recognized forms of aurorae. D. R. BARBER

551.594.5 : 523.72

3608. The aurora spectrum and the nature of the exciting solar particles. K. WURM. *Z. Astrophys.*, **25** (*Nos* 1–2) 28–57 (1948) *In German.*

Analysis of the observational facts, that the visual brightness of aurorae is mainly caused by the green O-line or by the red O-triplet, that in extreme cases a surface brightness equal to that of the full moon is reached, and that the diameters of the streamers are of the order of 1 km. The calculation of the number of emission processes per cm^3 per sec then gives, at a height of 100–150 km, 10^4–10^5 for the faintest and

10^{11}–10^{12} for the brightest observed aurorae. The question is asked, which role, besides the direct collisions of the intruding particles, the various possible secondary processes may play; it is shown that none of them counts for the total excitation. More than 90% of the latter is traced to excitation energies $\leqslant 6$ V. To explain this, it is suggested that H is the main constituent of the corpuscular streams. A density estimate, for those causing blu streamers, leads to at least 10^7 particles per cm^3.

A. BEE

551.594.6 : 621.396.821 : 621.396.1

3609. Variation of intensity of distant atmospheric with frequency channels. S. R. KHASTGIR AND A SEN. *Indian J. Phys.*, **23**, 483–94 (*Nov.*, 1949).

BIOLOGY 57/59

575.11

3610. Quantitative inferences concerning the genetic effects of radiation on human beings. R. D. EVANS. *Brit. J. Radiol.*, **23**, 175–83 (*March*, 1950).

577.3 : 537.591.8

Cosmic radiation and its biological effects. *See Abstr.* 3256

578.087.73

3611. Volumetric respirometer for aquatic animals. P. F. SCHOLANDER. *Rev. Sci. Instrum.*, **20**, 885–7 (*Dec.*, 1949).

578.087.77

3612. An electromagnetic blood flow meter. J. W. CLARK AND J. E. RANDALL. *Rev. Sci. Instrum.*, **20**, 951–4 (*Dec.*, 1949).

578.087.77 : 621.389

3613. An electronic method of tracing the movements of soil-inhabiting insects. A. P. ARNASON, R. A. FULLER AND J. W. T. SPINKS. *Science*, **111**, 5–8 (*Jan.* 6, 1950).

578.088 : 537.531

3614. Biological evaluation of 20 million volt roentgen rays. II. Decoloration of hair in mice. H. B. CHASE, H. QUASTLER AND L. S. SKAGGS. *Amer. J. Roentgenol. Radium Ther.*, **57**, 359–61 (*March*, 1947).

For Part I see Abstr. 1421 (1946).

578.088 : 537.531

3615. Biological evaluation of 20 million volt roentgen rays. III. Recessive sex-linked lethals in *Drosophila melanogaster*. W. M. LUCE, H. QUASTLER AND L. S. SKAGGS. *Amer. J. Roentgenol. Radium Ther.*, **62**, 555–8 (*Oct.*, 1949).

578.088.5

3616. On the action of metre waves on the division growth of plants. K. O. KIEPENHEUER, I. BRAUER AND C. HARTE. *Naturwissenschaften*, **36** (*No.* 1) 27–8 (1949) *In German.*

In certain trees the thickness of the annual rings in years of sunspot maximum exceed those in the minimum by 2–3 times. It is suggested that radiation from the sun in the region of metre waves $0{\cdot}5\text{ m} < \lambda < 15\text{ m}$ [see Abstr. 196 (1947)] in sporadic "bursts" may have some influence. Experiments were conducted on *Vicia Faba* seedlings exposed to linear polarized radiation from a 0·1 W valve oscillator $\lambda = 1{\cdot}5$ m h.f. fields of strength $\leqslant 2\times10^{-5}$ V/cm generally produce a growth increase up to 30% while with stronger fields there is a decrease of the growth rate.

T. A. CHALMERS

578.088..

3617. On the action of X-rays and fast electrons on mitosis of the root tip cells of Hordeum. H. BLECK W. PAUL, H. J. SCHMERMUND AND G. SCHUBERT *Naturwissenschaften*, **36** (*No.* 1) 28–9 (1949) *In German*

Barley corns after 24 hr in a thermostat at 22°C were irradiated with doses of 500–2 000 *r* of X-ray from a therapy tube operated at 180 kV and 0·25 mm Cu H.V.L. and others were irradiated with fast electrons from a 4 MeV generator. After an interval of 52 hr the root tips were fixed, stained and examined. Graphs are plotted showing the frequency of the chromosome fragments in relation to the dose in *r* units for X-rays and fast electrons, of cells in anaphase and telophase. The result of X-rays per dose unit seems to be more effective than the fast electrons. It is deduced from the curves that the X-ray biological effect is dependent upon > 1 "hit."

T. A. CHALMERS

578.088.7

3618. Electroencephalography. W. G. WALTER *Endeavour*, **8**, 194–9 (*Oct.*, 1949).

Short introductory review.

578.088.74

3619. A double pulse constant current stimulator R. L. SCHOENFELD. *Rev. Sci. Instrum.*, **20**, 827–9 (*Nov.*, 1949).

578.088.74 : 621.396.615.17

3620. An electronic stimulator for biological research V. H. ATTREE. *J. Sci. Instrum.*, **27**, 43–7 (*Feb.*, 1950)

A fast-acting relay is energized at frequencies in the range 0·005–500 c/s by an electronic square-wave generator. The relay has change-over contacts independent of earth, which may be used to give exponential condenser discharges in a conventional capacitor/resistance circuit. The square-wave generator triggers a pulse unit giving a square-pulse with an adjustable time-delay. The pulse duration and delay time are both in the range 50 μsec–50 msec. Independently adjustable pulses may be obtained from two such pulse units. Circuits for monitoring the output amplitude and mark/space ratio are given alternative output stages for both constant-current and balanced pulses are discussed.

A.

578.088.75 : 615.849

3621. Biological properties of microwaves. L. DE SÉGUIN. *Ann. Radioélectricité*, **4**, 331–43 (*Oct.*, 1949) *In French.*

Review. 10 figs., 4 photographs, 2 tables.

595.7

3622. Sensitivity of ants to polarised light. D. M. VOWLES. Letter in *Nature, Lond.*, **165**, 282–3 (*Feb.* 18, 1950).

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.84

3623. The influence of colour adaptation of the eye on its reactivity with regard to inadequate stimuli. S. V. KRAVKOV. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 2) 203–6 (1949) *In Russian.*

The adaptations to red and green light and to sound were tested for the consequent variations in sensitivity. As inadequate stimulus direct current of 0·3 mA was applied by placing the active electrode against the temple, the inactive one in the opposite hand of the subject. During condition of anaelectrotonus the sensitivity for 520 mμ and 630 mμ increases after adaptation to red light, decreases after green adaptation. The same sensitivity-variations occur under sound stimulation, with a frequency of 980 c/s, and loudness 85 db. Kataelectrotonus conditions reverse the changes in sensitivity for 520 mμ. J. JACOBS

612.84

3624. Contrast discrimination charts for demonstrating the effect of anoxia on vision. S. HECHT, C. D. HENDLEY, S. FRANK AND S. SHLAER. *J. Opt. Soc. Amer.*, **39**, 922–3 (*Nov.*, 1949).

612.84

3625. The quantum- and classical-photochemical theories of vision and nervous inhibition at the visual threshold. E. BAUMGARDT. *Rev. Opt.* (*Théor. Instrum.*) **28**, 661–90 (*Dec.*, 1949) *In French.*

In continuation of previous work [Abstr. 2106 (1950)], an arrangement is described by means of which extremely short stimuli can be applied to the eye (>4 μsec). The fovea and loci 15° outside it are examined, the angular field of the test object varying from 2·2′ to 8°. At 15°, blue light (0·48 μ) Ricco's law applies up to 45′. From 1·6° it is replaced by Piper's law. For red light ($\lambda > 0{\cdot}68$ μ) the latter applies between 8′ and 6°. Ricco's law holds between 4 and 6′ if no artificial pupil is used. Thus it is a preretinal and not a retinal mechanism which effects spatial integration in this range of visual angles. Extrafoveally there is no photochromatic threshold. The spatio-temporal intensity relations are thought to confirm the belief that two photons are required to trigger the visual mechanism. The period within which they must reach the extrafoveal region varies in the blue from 4 to 100 msec as the visual angle changes from 8° to 2′. In the red it is 100 msec independently of the angle subtended by the test object: Evidence is adduced to show that a purely photochemical explanation of retinal sensitivity changes is untenable: a case is presented for the belief in a nervous mechanism. Graphs, diagrams and tables are given. R. A. WEALE

612.84

3626. Comparison of the Nagel anomaloscope and a dichroic filter anomaloscope. L. L. SLOAN. *J. Opt. Soc. Amer.*, **40**, 41–7 (*Jan.*, 1950).

612.84

3627. The chromatic aberration of the human eye and its physiological correction. H. HARTRIDGE. *Experientia*, **6**, 1–10 (*Jan.* 15, 1950).

The correction of this defect is explained by the writer's theory of antichromatic responses [*Philos. Trans. B*, 232–523 (1947)]. Evidence for the existence of an independent yellow receptor and a qualitative account of the polychromatic theory are given. Graphs but no new experimental data are presented. R. A. WEALE

612.84

3628. Colour perception in parafoveal vision. M. GILBERT. *Proc. Phys. Soc., Lond. B*, **63**, 83–9 (*Feb.*, 1950).

612.84 : 525.722 : 551.593.12

The scintillation of stars. *See Abstr.* 3584

612.843.32

3629. On the limit of the visual sensitivity in the red. M. CZERNY. *Z. Naturforsch.*, **40**, 521–3 (*Oct.*, 1949) *In German.*

From recent data on the infrared sensitivity S of the human eye [Abstr. 3389 (1947)], it is deduced that $S \propto \lambda^{-3} \exp(-0{\cdot}00462/\lambda)$, λ being the wavelength. It is shown that the number of energy-absorbing molecules [of an unspecified visual substance] must increase in the same measure because otherwise a dark-reaction would impede the visual process. An attempt is made to deduce both the number of quanta and the number of molecules impinging on 1 cm² of the receptor. R. A. WEALE

612.85

3630. The watch, an apparatus for measuring auditive acuity. P. CHAVASSE, R. CAUSSÉ AND R. LEHMANN. *Ann. Télécommun.*, **4**, 413–24 (*Dec.*, 1949) *In French.*

The characteristics of watches, particularly the relative duration of noise and silence and the repetition frequency have been studied. The difficulties of obtaining a spectral analysis of such noise are emphasized, the various methods of measurement are reviewed and specimen results are given. The use of the watch by otologists is discussed and the physiological deductions which can be made are outlined. G. F. HODSMAN

612.85

3631. Subjective effects in binaural hearing. W. KOENIG. Letter in *J. Acoust. Soc. Amer.*, **22**, 61 (*Jan.*, 1950).

614

3632. Environmental warmth and human comfort. T. BEDFORD. *Brit. J. Appl. Phys.*, **1**, 33–8 (*Feb.*, 1950).

614.8

3633. Safe handling of radioisotopes. G. G. MANOV AND D. O. LINTZ. *Mech. Engng, N.Y.*, **71**, 991–8 (*Dec.*, 1949).

614.8

3634. Safe handling of radioactive isotopes. *Handb. U.S. Bur. Stand.* (*No.* 42) 30 *pp.* (1949).

614.8

3635. Radioactive risks and protection against them. J. W. OTTE. *Rev. Geofis.*, **8**, 327–87 (*April–Sept.*, 1949) *In Spanish.*

An extensive review with 9 pp. of references.

L. PINCHERLE

614.8

3636. Radiation-exposure survey of X-ray and isotope personnel. C. K. SPALDING, E. DEAMICIS AND R. F. COWING. *Nucleonics*, **5**, 63–6 (*Dec.*, 1949).

Statistics obtained from the examination of developed dental films worn by personnel of X-ray departments and radioisotope laboratories. Results indicate that the X-ray workers receive the greater exposure. L. R. SHEPHERD

614.8

3637. Magnetite concrete for radiation shielding. E. CREUTZ AND K. DOWNES. *J. Appl. Phys.*, **20**, 1236–40 (*Dec.*, 1949).

A concrete containing only magnetite ore concentrate, cement and water is found to have appreciably better shielding properties than ordinary concrete, and to possess good strength and ease of handling. Its use is desirable under certain conditions because of space economy due to its high density. A.

614.8

3638. Medical aspects of protection from ionizing radiations. F. ELLIS. *Brit. J. Radiol.*, **23**, 28–34 (*Jan.*, 1950).

The max. dose to any point in the body is more important than volume dose, and the main danger is considered to be the causation of cancer. Mutations in animals are found to result only from doses far above the accepted tolerance level. Measurements of dose to fingers and other parts of the body of radium workers are given and are related to the clinical operations carried out. F. T. FARMER

614.8

3639. Radiobiological additivity of various ionizing radiations. R. E. ZIRKLE. *Amer. J. Roentgenol. Radium Ther.*, **63**, 170–5 (*Feb.*, 1950).

614.8

3640. Some biologic effects of long continued irradiation. E. LORENZ. *Amer. J. Roentgenol. Radium Ther.*, **63**, 176–85 (*Feb.*, 1950).

614.8

3641. Health hazards in radiation work. M. INGRAM. *Science*, **111**, 103–9 (*Feb.* 3, 1950).

614.8 : 539.16.08

A portable roentgenmeter for field use. *See Abstr.* 3339

615.831 : 621.317.794 : 621.383

3642. Measurements of erythemal energy. H. S. SCOTT. *Trans Amer. Inst. Elect. Engrs*, **68** (*Pt I*) 725–9 (1949).

An instrument for measuring u.v. in the narrow biologically active band, using photo-cell and galvanometer, is described. A close approximation to skin response is achieved by a combination of filters and fluorescent phosphor, and spectral curves for the various components are given. F. T. FARMER

615.849

3643. External measurement of radio-iodine in the thyroid gland. T. H. ODDIE AND R. K. SCOTT. *Brit. J. Radiol.*, **22**, 698–705 (*Dec.*, 1949).

615.849

3644. Advances in X-ray therapy apparatus. A. J. MINNS AND D. H. DONALDSON. *Brit. J. Radiol.*, **23**, 125–35 (*Feb.*, 1950).

Reviews the advances that have been made during the past 10 years in the design of X-ray tubes and therapy equipment for voltages from about 5 kV to 2 MeV, and indicates the probable course of further development.

616–073.7

3645. Screen intensification systems and their limitations. R. E. STURM AND R. H. MORGAN. *Amer. J. Roentgenol. Radium Ther.*, **62**, 617–3 (*Nov.*, 1949).

Radiological screens give poor detail as compared to film detail. It is a general belief that increased screen brightness would give increased perception of detail, particularly since radiographs made with the film in contact with the X-ray fluorescent screen show increased detail as compared to the visual screen detail. Hence the deficiency may be attributed to the human eye and it may be considered that, if the brightness of the screen is increased, detail perception will result. Rose has shown that the function of the eye is limited by the statistical fluctuations in the number of photons reaching the retina. Such fluctuations are $\propto$ the square root of the average number of photons reaching the eye within its storage time (about 0·2 sec). Illustrated by coin tossing experiments, the fluctuation theory is applied to X-ray screen observation, in which various factors are the cause of fluctuations. From this theory an expression is derived in terms of (1) number of photons reaching the retina per sec per mm screen area, (2) amplification factor in respect to minimal intensity, (3) occular storage time, (4) threshold contrast to tolerable fluctuation ratio, which expresses the practically known fact that the greater the contrast the better is the perception of minute shadows and that, with increase of screen brightness, the size of the smallest perceptible object diminishes. Practical tests have been made to determine the relative merits of screen intensification and radiographic perception particularly since it has been considered the former could equal the latter. Tests were made with a tube operated under clinical conditions and, after detailed consideration of the effects of the various factors results are given of tests made of the visual perception of various observers by use of a Pb plate having holes of diminishing size. These tests are considered to establish the correctness of the fluctuation theory. Visual screen perception can be increased by increasing of the tube voltage and current, but danger to patient and operator arises. Screen intensification devices are not yet developed sufficiently to permit general practical applications, but the results derived from the theory advanced suggest that its use will be applicable in thoracic examinations, where detail perception will approach film detail perception, but it is unlikely to be of practical value in respect to abdominal examinations, particularly examination of the abdomen laterally, i.e. the advantages are not so impressive as generally assumed. The chief advantage will be elimination of the need of prior adaptation of the observer's eyes. B. J. LEGGETT

616–073.75 : 621.386.84

3646. Clinical potentialities of screen intensifying systems. R. H. MORGAN AND J. F. ROACH. *Amer. J. Roentgenol. Radium Ther.*, **62**, 635–44 (*Oct.*, 1949).

Part of "Report of 49th Annual Meeting of

merican Roentgen-ray Society," Chicago, Sept., 948. Morgan states advantages of intensified luorescent X-ray pictures to radiologist (no dark daptation) and to patient (reduced incident dose). Moon outlines preliminary experiments with a "scanning" X-ray tube, adapted from a television ube by replacing the screen with a target of Ta 4×7×0·001 in). This target is scanned by the athode electrons (525 lines, 30 frames/sec). The ine, travelling pencil of X-rays thus produced by ransmission through the target, leaves the Pb casing through a pinhole (virtual source of X-rays). The object to be radiographed is placed in front of a fast (< 1 μsec) fluorescent screen. Light pulses from the screen, corresponding to the position of the X-ray pencil, are directed to a photomultiplier, then further amplified, and used to modulate a c.r.t., thus reproducing the object. Increases in rating and efficiency are contemplated, but inherent limitations of the pinhole diaphragm seem insurmountable at present (Morgan) and point more favourably to Coltman's amplification system [Abstr. 1615 (1949)].

D. V. MABBS

TECHNICAL MATERIALS 66/67

666

3647. Optical properties and the constitution of glass. F. L. Jones and N. J. Kreidl. *J. Soc. Glass Tech.*, **33**, 239–54T (*Aug.*, 1949).

666 : 537.226.2

The dielectric properties of glass and their structural interpretation. *See Abstr.* 3144

PHOTOGRAPHY 77

77.01

3648. On the photographic reciprocity law failure and related effects. I. The low intensity failure. E. Katz. *J. Chem. Phys.*, **17**, 1132–41 (*Nov.*, 1949).

77.01 : 537.531

3649. Quantum efficiency in photographic X-ray exposures. D. Bromley and R. H. Herz. *Proc. Phys. Soc., Lond. B*, **63**, 90–106 (*Feb.*, 1950).

The grain yield per absorbed quantum has been evaluated experimentally for 4 different emulsions over a wavelength range of 1·2–0·01 Å, i.e. from very soft X-rays to γ-rays emitted from Ra. The tests were carried out with both heterogeneous and monochromatic X-rays. A grain yield of 1·0 per absorbed quantum appears to hold within a range of wavelengths of 1·2–0·37 Å (10 kV–33 kV). From 0·37 Å to short wavelengths (γ-rays) an increase of grain yield linear with quantum energy is obtained. At a wavelength of 0·0123 Å (1 000 kV) about 10 grains are rendered developable per quantum absorbed. The rate of increase of grain yield with quantum energy is different for different emulsions. For a slow and fine-grain chloro-bromide emulsion the grain yield was found to be < 1 for wavelengths below 0·12 Å (i.e. 100 kV). The results are consistent with the hypothesis that grains are made developable not only by the direct action of X-rays but also by secondary electrons produced by the X-rays. These are effective only when they are energetic enough to reach grains in the neighbourhood of that absorbing the original X-ray quantum. A.

77.023.4

3650. Latent-image distribution by X-ray exposures. I. Kornfeld. *J. Opt. Soc. Amer.*, **39**, 1020–1 (*Dec.*, 1949).

771.376.2 : 551.521

3651. Errata: Sunlight and skylight as determinants of photographic exposure. II. Scene structure, directional index, photographic efficiency of daylight safety factors, and evaluation of camera exposure. L. A. Jones and H. R. Condit. *J. Opt. Soc. Amer.*, **39**, 790 (*Sept.*, 1949).

See Abstr. 6653 (1949).

771.53

3652. Dependence of the sensitivity of unsensitized photographic emulsions upon temperature. M. Biltz. *J. Opt. Soc. Amer.*, **39**, 994–1008 (*Dec.*, 1949).

771.53

3653. Measurements on enlargements on plates and the construction of a new type of photoelectric granularity meter. R. Debot. *Research, Lond.*, **3**, 91–6 (*Feb.*, 1950).

Describes the results of measurements of the statistical distribution of the local fluctuations in transparency and density in photographic enlargements. Discussion of the results shows that accurate relationships exist between measurements of granularity based on one or other quantity, the variations of which are analysed. Previously published theoretical formulae are very well verified. It is further pointed out that it is necessary to measure the granularity around a large number of points on the granular test strip since individual measurements scatter widely owing to the nature of the subject under investigation. A photoelectric granularity meter is described which gives directly values of the mean square deviation σ_T of the transparency. It will rapidly determine σ_T values from 0·5 to around 0·01, for scanning spots with diameters which can be varied from 3·5 μ to several mm. [See Abstr. 6655 (1949)]. A.

771.534.524 : 535.247.4 : 621.317.39

3654. Darkroom light meter. S. BECKER. *Electronics*, **22**, 90–1 (*Nov.*, 1949).

771.534.589

3655. On the theory of the Sabattier effect. III. Verification of the theory. H. ARENS. *Z. wiss. Photgr.*, **44** (*Nos* 8–9) 172–81 (1949) *In German.*

The theory of the Sabattier effect [Abstr. 7497–8 (1949)] is verified by experiments. Evidence is shown for the dependence of the effect on the internal latent image and its independence of surface latent image. The influence of the time of pre-development on the occurrence of the effect and the function of the pre-development are discussed. R. H. HERZ

771.535

3656. Light absorption by latent photographic image centres. P. V. MEĬKLYAR. *Dokl. Akad. Nauk, SSSR*, **69** (*No.* 1) 23–6 (1949) *In Russian.*

Under certain conditions of illumination some centres of the latent image ("subcentres"), resist development, but on absorption of light create free electrons and thus developed centres are formed in the image on exposure to red light. These subcentres are found to be most numerous with brief and intense illuminations. Experimental methods are described, whereby the spectral distribution of light absorption by these subcentres can be determined. Results show that light absorption zones are determined by the minute particles of Ag formed in the emulsive crystal during illumination. Tables show: (*a*) dependence on wavelength of difference between light sensitivity curves at various degrees of illumination for (i) slide plates, (ii) Printon films; (*b*) for (ii) above, data, by zones and periods, for (1) logarithm of quantity of illumination, depending on period of exposure, (2) plate sensitivity changes. J. CLEUGH

778.3

3657. Fading of nuclear track emulsions. L. WINAND AND L. FALLA. *Bull. Soc. Roy. Sci. Liége*, **18**, 184–9 (*April–May*, 1949).

Fading of latent-images produced by light has been investigated in Ilford *C*2 and *B*2 plates, as well as in 4 experimental emulsions. These latter are pure AgBr emulsions with a AgBr/gelatin ratio of 4 : 1 by weight, being, however, less sensitive to nuclear particles than the special emulsions. They are sensitive to α-particle tracks and recoiled protons originating from a Ra–Be source. It is concluded that fading is larger the smaller the density and is more pronounced for the special *NT* emulsions than for the experimental emulsions. The densities in question are situated in the region of under-exposure and on the straight-line portion of the characteristic curve. Treatment in Na nitrite was found to eliminate fading practically completely and fading is therefore thought to be connected with the recombination of Ag and Br. PHOTOGRAPHIC ABSTRACTS

778.3

3658. Fast fine grain emulsions and the recording of electron tracks. R. W. BERRIMAN. *Photogr. J.*, **89B**, 121–3 (*Sept.–Oct.*, 1949).

A 50 keV electron and a singly-charged particle of min. ionizing power, in traversing the max. dimension of a AgBr grain of 0·2 μ diameter will release 50 and 15 electrons respectively into the conducti levels of the grain. The present NT-2a emulsio with a grain size of 0·2 μ, will yield tracks of electro with energies of up to 50–80 keV, and since a average grain in a photographic emulsion requir about 40 light quanta to form a latent image, it concluded that latent image formation by nucle particles in the NT-2a emulsion is comparable efficiency with that of light. A 3-fold increase sensitivity over the present NT-2a is required order to obtain sensitivity to min. ionization, an this could be achieved either by a 3-fold increase grain size or a 3-fold increase in the efficiency latent image formation. The latter is not ruled o on energy grounds, for the most sensitive grains in photographic emulsion require only 10 light quan to form a latent image.

778

3659. Physical optic analysis of image quality schlieren photography. H. J. SHAFER. *J. Soc. M Pict. Engrs*, **53**, 524–44 (*Nov.*, 1949).

The effect of aperture, focal length, light-sour size, and knife-edge position on the quality schlieren photographs is discussed. A mathematic analysis of the subject is presented. On the basis this analysis the schlieren system is considered usi a point source. The case of finite-source size is the discussed. A brief discussion of the effect of asti matism on the focal length of the system is als presented.

778.

3660. Precise reconstruction in space of phenomen observed in photographic plates for nuclear researc L. VIGNERON. *J. Phys. Radium*, **10**, 305–12 (*Nov* 1949) *In French.*

The shrinkage factor ($k = V_0/V$) defined as th ratio of the volumes of a nuclear track emulsio before (V_0) and after processing (V) has been ca culated from the known composition of Ilford nuclea research emulsions. The calculated result $k = 2{\cdot}2$ differs appreciably from that given by the manu facturers of the plates ($k = 1{\cdot}66$). It is shown tha the value of k depends critically on relatively sma variations of the ratio in weight of the constituen of the emulsion to gelatin. The errors involved i the eyepiece (u) and depth (v) calibration of th microscope lead to a factor $k' = u/v$ which has to b considered for the measurement of the shrinkag factor. The evaluation of this factor and its influenc on the determination of the vertical and horizonta component of particle tracks are discussed in detai The shrinkage factor eventually obtained afte correction, using the factor k', is found to b $2{\cdot}16 \pm 0{\cdot}07$. R. H. HER

778.

3661. Low intensity reciprocity-law failure in photo graphic exposure: energy depth of electron traps i latent-image formation; number of quanta required t form the stable sublatent image. J. H. WEBB. *J. Op Soc. Amer.*, **40**, 2–13 (*Jan.*, 1950).

778.

3662. Background eradication in thick-layere nuclear emulsions. M. WIENER AND H. YAGODA *Rev. Sci. Instrum.*, **21**, 39–41 (*Jan.*, 1950).

A method for eradication of accumulated back

ground on Ilford *C*2 plates, 100–200 μ thick, without reducing their sensitivity to medium ionizing particles, is described. The method involves a mild oxidation of the emulsion by air saturated with water vapour at 35°C for a period of about 16 hr. The plates are then dried and are ready for experimental exposure. Analysis of grain counts shows no loss of sensitivity in proton tracks over their last 200 μ range when the plates are developed with a mild hydroquinone developer. Complete eradication of background α-tracks and stars is secured as well as destruction of latent images of the less ionizing proton recoils instigated by external neutron bombardment. Grain density studies on proton tracks located at different depths in the emulsion indicate substantially uniform sensitivity after eradication except for the uppermost 50 μ which develop with about a 10% reduction in mean grain density as compared with tracks deep within the recording medium. A.

778.3

3663. Variation of grain density with temperature of exposure in nuclear emulsions. E. M. DOLLMANN. *Rev. Sci. Instrum.*, **21**, 118–19 (*Feb.*, 1950).

Ilford *C*2 unloaded and *C*2 B-loaded plates, subjected to temperature changes varying from − 66°C to + 66°C, were bombarded with 10-MeV neutrons. The recoil protons showed that the temperature change had caused an increase in grain density which varied as much as ½ from − 66°C to + 25°C. Although the *C*2 B-loaded plates showed a greater initial grain density than the unloaded plates, the ½ increase was preserved. A.

778.3 : 539.18

3664. On the measurement of the mass of charged particles by grain counts in sensitive emulsions. L. VAN ROSSUM. *J. Phys. Radium*, **10**, 402–11 (*Dec.*, 1949) *In French.*

The mass of negative π-mesons has been determined by the magnetic deflection and by the grain count method, using nuclear track emulsions which have been exposed to the Berkeley cyclotron. The results obtained with the two methods which are described in detail agree within the statistical error ($m_\pi = 280\, m_e$) and confirm the results obtained by the Bristol and Berkeley school. The mass of one meson determined also by both methods has been found to be $> 350\, m_e$. The absence of events (π^-, μ) has been confirmed and the frequency of events in which electrons are emitted in the disintegration of π^- mesons has been found to be the same as that stated by the Bristol school, although the emulsion used was not sensitive at minimum ionization. In 4 events the electron is emitted in a direction close to that of the incident meson and in 2 cases, in addition to the electron track, stars have been produced by 2 fast particles emitted in directions almost normal to that of the incident meson. Expressions based on the energy loss in keV per μ have been derived for the study of the number of grains rendered developable per μ of track up to 50 kV. R. H. HERZ

778.3 : 537.531

Spectral analysis of 10-MeV betatron radiation by nuclear emulsion. *See Abstr.* 3179

778.3 : 537.534.75

Stopping power of nuclear emulsions for ionizing particles. *See Abstr.* 3199

778.3 : 539.16.08

Detection of radioactive atoms in the air with nuclear emulsions. *See Abstr.* 3340

778.3 : 539.16.08

On the use of the photographic emulsion in the determination of the radioactivity of rocks. *See Abstr.* 3341

778.3 : 539.164

3665. Herschel effect on α-particle traces in photographic emulsions. H. SAUVENIER AND L. WINAND. *Bull. Soc. Roy. Sci. Liége*, **18**, 156–60 (*April–May*, 1949).

Using Ilford *C*2 plates, the effect of illumination by red light has been studied both on density patches produced by α-particles and on individual tracks. It is shown that a pronounced Herschel effect can be obtained in both cases. It is shown that illumination by red light does not affect the sensitivity of plates to α-particles. PHOTOGRAPHIC ABSTRACTS

778.3 : 539.164

3666. Evidence for printing-out produced in *NT* emulsion by α-polonium particles. L. WINAND. *Bull. Soc. Roy. Sci. Liége*, **18**, 161–3 (*April–May*, 1949).

It is shown that α-particles are capable of causing a print-out image in photographic emulsions (Ilford *C*2 and *G*5). The energy necessary to produce a threshold image is of the same order for α-particles and for light. On the whole, α-particles are considerably less effective in producing a print-out image than light. In this comparison, however, no halogen acceptors were added to the emulsion.

PHOTOGRAPHIC ABSTRACTS

778.3 : 621.383

3667. An electro-optical shutter for photographic purposes. A. M. ZAREM, F. R. MARSHALL AND F. L. POOLE. *Trans. Amer. Inst. Elect. Engrs*, **68** (*Pt. I*) 84–91 (1949).

See Abstr. 2506 B (1949).

778.33

3668. The reproduction of radiographs. I. H. S. TASKER. *Photogr. J.*, **89B**, 113–15 (*Sept.-Oct.*, 1949).

778.33

3669. The fundamental action of intensifying screens in gamma radiography. E. L. HARRINGTON, H. E. JOHNS, A. P. WILES AND C. GARRETT. *Non-Destr. Test.*, **8**, 23–7 (*Fall*, 1949).

Measurements of the contributions due to electrons emitted from Pb screens in front of and behind the film are compared with those for Patterson screens. In both cases it is found that about 52% of blackening is due to the front screen and 48% to back, with a small contribution from absorption in the film itself. With Patterson screens there is an additional effect due to light emitted, amounting to 10% of the total blackening. F. T. FARMER

778.33

3670. An analysis of the physical factors controlling the diagnostic quality of Roentgen images. V. Unsharpness. R. H. MORGAN. *Amer. J. Roentgenol. Radium Ther.*, **62**, 870–80 (*Dec.*, 1949).

The factors causing unsharpness, viz. focal spot

size, movement and film grain, are expressed mathematically, and it is shown that when they operate simultaneously the maximum gradient of penumbra is determined by the largest factor alone. Experiments in perception show that this gradient, and not the total width of penumbra, is the significant quantity influencing blurredness in a radiograph. F. T. FARMER

778.33 : 539.165

3671. Radiography with beta-rays. T. WESTERMARK. Letter in *Nature, Lond.*, **164,** 1086–7 (*Dec.* 24, 1949).

Fine detailed radiography is achieved by placing a thin specimen on a film and exposing with a β-ray isotope. Results are shown for a plant leaf, a mineral specimen and a mica sheet. F. T. FARMER

778.33 : 539.26

3672. Microradiography of metals and alloys [review]. K. A. IVANOV. *J. Tech. Phys., USSR,* **19,** 1217–30 (*Nov.*, 1949) *In Russian.*

The technique of transmission microradiography is described in detail. Fine grain plates are used and all magnification (usually $\times 50$–200) is made optically. Choice of radiation permits identification of phases and achievement of high contrast. The surfaces of the specimens (sheets of 0·1 mm thickness) need not be polished as the whole volume is examined. Flaws are easily seen. Alternatively, X-rays may fall almost tangentially on to a thick specimen giving rise to diffracted beams which can be record.d on a plate close to the surface and shielded from the direct beam. Grain size and deformation may be estimated from the size and sharpness of the images. (17 references.) A. L. MACKAY

778.534.8

3673. High-speed motion pictures by multiple-aperture focal-plane scanners. F. E. TUTTLE. *J. Soc. Mot. Pict. Engrs,* **53,** 451–61 (*Nov.*, 1949).

Heretofore, in all high-speed photography instantaneous time covered one complete frame, the continuity of instantaneous frames forming the time axis. A new method of obtaining high-speed pictures is described whereby instantaneous time covers multiple small portions of a single frame, the total area of these small portions being sufficient to provide detail and the single frame being large enough to permit unmagnified observation. A.

778.534.8

3674. Improvements in high-speed motion pictures by multiple-aperture focal-plane scanners. F. E. TUTTLE. *J. Soc. Mot. Pict. Engrs,* **53,** 462–8 (*Nov.*, 1949).

It is shown how, with the multiple-aperture scanning method of high-speed photography, the absolute number of entirely new position pictures of a moving object is more a function of how many grains of emulsion are uncovered in the total aperture travel than a function of the number of aperture widths uncovered. This results in many more frames per event than had been assumed heretofore. A second camera of this type is described in which two-dimensional scanning gives composite pictures with a dot structure. This is accomplished by means of a rotating disc. This camera is capable of taking high-speed pictures at the rate of at least 1 000 000 pe sec. A

778.534.

3675. Twenty-lens high-speed camera. C. W WYCKOFF. *J. Soc. Mot. Pict. Engrs,* **53,** 469–7 (*Nov.*, 1949).

A brief description of the Jenkins camera is pre sented with illustrations of the optical principles. covers a 35 mm sound aperture, holds up to 200 of film and has been operated up to 2 350 picture per sec at *f*/9. A

778.534.

3676. Half-million stationary images per secon with refocused revolving beams. C. D. MILLE *J. Soc. Mot. Pict. Engrs,* **53,** 479–88 (*Nov.*, 1949).

778.534.

3677. Very-high-speed drum-type camera. K. M BAIRD AND D. S. L. DURIE. *J. Soc. Mot. Pict. Engrs* **53,** 489–95 (*Nov.*, 1949).

A drum-type camera designed to take pictures a any rate up to 200 000 frames per sec is describe A total of 1 300 frames of the 16 mm frame size ar recorded on a single piece of film from which the can be printed directly for projection and analysis. A

778.534.

3678. Design of rotating prisms for high-spee cameras. J. H. WADDELL. *J. Soc. Mot. Pict. Engrs* **53,** 496–501 (*Nov.*, 1949).

Principles of design of rotating prisms for high speed cameras are discussed. A new approach i used in the principles and prisms of higher resolutio can be obtained by following this approach. A

778.534.

3679. Bowen ribbon-frame camera. E. E. GREE AND T. J. OBST. *J. Soc. Mot. Pict. Engrs,* **53,** 515–2 (*Nov.*, 1949).

A brief background is given of this camera, deve loped for the study of rockets and guided missile under free-flight conditions. The main constructiona features are discussed as well as the orienting syste used on the rocket range. Timing and camera phasing devices are mentioned which make the film record assessable to an accuracy of 20 μs. A

778.

3680. Subtractive color reproduction. The approxi mate reproduction of selected colors. W. L. BREWE W. T. HANSON, JR. AND C. A. HORTON. *J. Opt. Soc Amer.*, **39,** 924–7 (*Nov.*, 1949).

778.6 : 535.6

Evaluation of colorimetric stimuli. *See Abstr.* 169

778.6

3681. Colour domain and luminance of the additive process in colour photography. W. N. SPROSON *Photogr. J.*, **89B,** 107–12 (*Sept.–Oct.*, 1949).

Luminance contours are computed for an idea colour screen and compared with the total possibl colour range. The most important limitation is th reduction of luminance by a factor of 3. Data ar given for a practical application (Dufaycolor) and it performance is compared with the ideal colour screen A further comparison is made between ideal additive and subtractive processes. A

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